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THE
NEW SYSTEM OF GYNAECOLOGY

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THE NEW SYSTEM OF GYNAECOLOGY

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VOLUME III

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DISEASES OF THE BREAST

By Charles C. Choyce, F.R.C.S.
(London)

Anatomy and Physiology

The *breast* is a discoid, compound, racemose gland, developed from the skin-layer of the thoracic wall. It is surrounded by adipose tissue of which the interlobular fibrous strands connect the breast on the one surface to the skin (suspensory ligaments of Astley Cooper), and on the other to the fascia covering the pectoralis major and other underlying muscles. Fatty areolar tissue separates the lobes and lobules and also forms a covering and a bed for the whole gland ; in the neighbourhood of the areola, however, it is absent.

Each breast is composed of from twelve to twenty distinct wedge-shaped lobes, radiating from the nipple as a centre. Each lobe forms a sector of the whole disc of the breast ; it is functionally and anatomically independent of its neighbours, and possesses a main duct which opens at the summit of the nipple. It will be seen that certain diseases, such as mastitis, tend to retain this sector-shaped distribution, and that isolated lobes or groups of them can be excised, or destroyed, without material interference with the rest of the organ.

The ultimate ramifications of each lobe consist of groups of cubical epithelial secreting cells resting on a fine basement membrane composed of endothelial cells. The alveoli drain into small ducts which, uniting, form lobular ducts, each lined by a single layer of columnar cells supported by a basement membrane. These in turn combine to form the main or galactophorous duct of the lobe which, just before it reaches the base of the nipple, expands to form a small reservoir or ampulla about $\frac{1}{8}$ to $\frac{1}{4}$ inch wide. If the small superficial opening at the end of the nipple becomes blocked the ampulla may become distended to form a retention cyst, filled with serous fluid; if the patient be lactating at the time, milk replaces the serous fluid and a galactocele is formed.

The *nipple* is composed of the galactophorous ducts closely packed in a connective tissue containing unstriped muscular fibres and a free supply of vessels capable of considerable alterations in calibre; it is therefore an erectile organ. Its skin has a thin epidermis and many sebaceous glands. Its base is surrounded by an areola, or circle of skin, which varies in colour from pink to dark brown in correspondence with the general complexion of the individual.

On the nipple are a number of very sensitive papillae; on the areola there are from twelve to sixteen small glandular projections, the follicles of Montgomery, which enlarge during pregnancy and serve to secrete a lubricant fluid.

The size of the breast has no bearing on its *functional capabilities*; a large breast may be composed chiefly of fat and secrete milk in deficient quantity or quality; a flat breast may be physiologically adequate.

The *extent of the breast* is much wider than is immediately obvious. Outlying processes are to be found far beyond the apparent edges, gradually merging into the surrounding fatty tissue. Stiles, who has especially emphasized the lack of a distinct capsule of the breast, recommends that, to demonstrate outlying islets of breast-parenchyma, slices of the suspected tissue should be immersed in 5 per cent HNO_3 for a few minutes to coagulate the albumen of the epithelial cells and to render the connective tissue "transparent, homogeneous, and somewhat gelatinous." After washing in running water the ultimate ramifications of the mammary tissue can be seen as dull, opaque, white, seed-like bodies round the finer ducts. He states that breast-tissue can sometimes be seen in some of the ligaments of Astley Cooper. Similar processes have been demonstrated by Heidenhain in the retromammary tissue, and even in the fascia in the interstices of the pectoralis major. Mammary tissue extends in the midclavicular line from the second rib above to the sixth costal cartilage below; whilst its horizontal diameter at the level of the fourth chondrosternal junction may be taken as from the midaxillary line to quite close to the midsternal line.

In addition an *axillary tail* very frequently winds round the lower border of the pectoralis major to reach the base of the axilla, as high as the third rib, and to come into close relationship with the glands in the inner wall of the axilla.

Relations to Underlying Muscles.—It will be seen therefore that although two-thirds of the organ rests on the pectoralis major a large infero-external portion is in immediate relation with the serratus magnus, and the flattened lower edge is in contact with the fasciae of the external oblique and *rectus abdominis* muscles.

Moreover, the breast tends to curl round the lower border of the pectoralis major and to reach the serratus magnus and the neighbourhood of the pectoralis minor. Appreciation of these wide muscular and fascial relationships is exceedingly important in the removal of the breast for cancer, for the lymphatic spaces of the fascia are early permeated by cancer-cells; no operation is adequate that fails to remove all the muscles and aponeuroses in contact with the gland and its extensions.

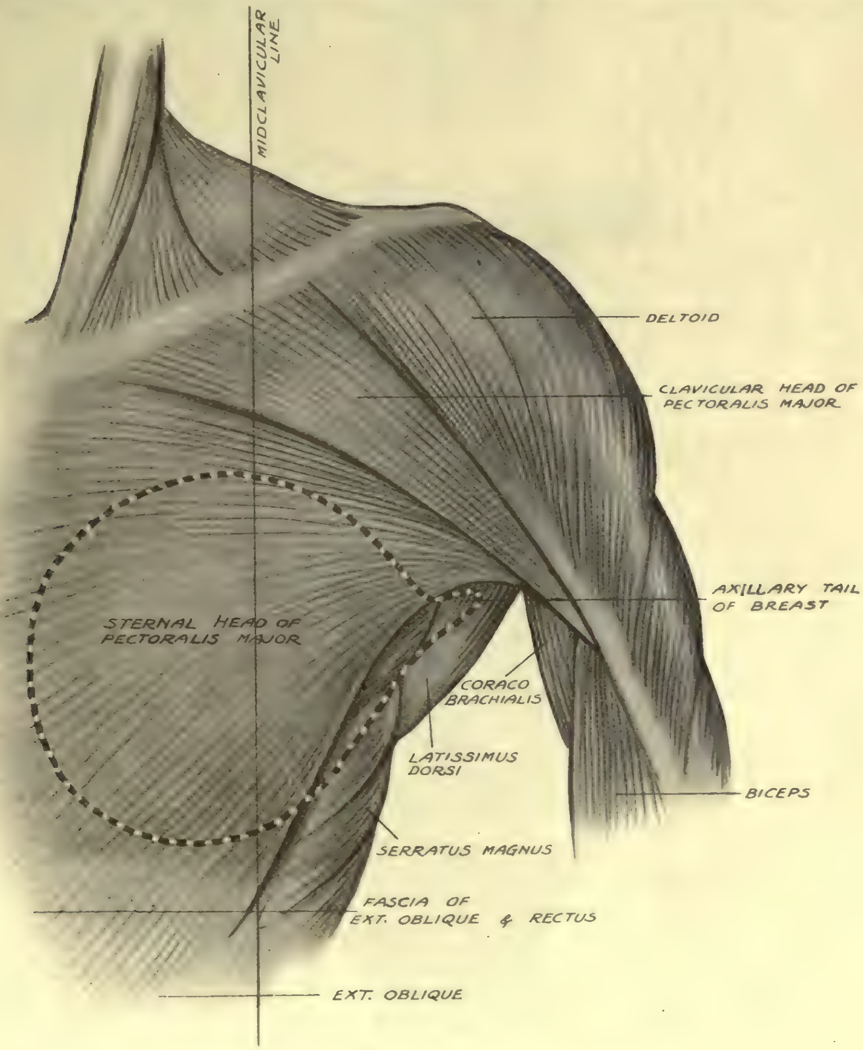

Fig. 1.—Diagram to illustrate muscles underlying the breast.
One-third of the breast lies on the flank beyond the boundaries of the pectoralis major. This fact cannot be made clear in the position of this drawing.

The thicker the layer of muscle between a carcinomatous breast and the pleura and peritoneum the better the prognosis, other things being equal; therefore the prospects of cure are worse in a spare patient than in a well-nourished muscular one, and in the outlying parts of the breast than in the parts overlying the thick pad of the pectoralis major.

The *arterial* supply to the breast comes chiefly from the internal mammary, long thoracic, superior thoracic, and second, third, and fourth intercostal arteries. As most of these come from above, and as the perforating branches of the internal mammary artery turn round the edge of the gland to enter its anterior surface, the incision planned by Gaillard Thomas interferes but little with the vascular supply of the organ. This incision, made in the submammary sulcus, permits raising of the

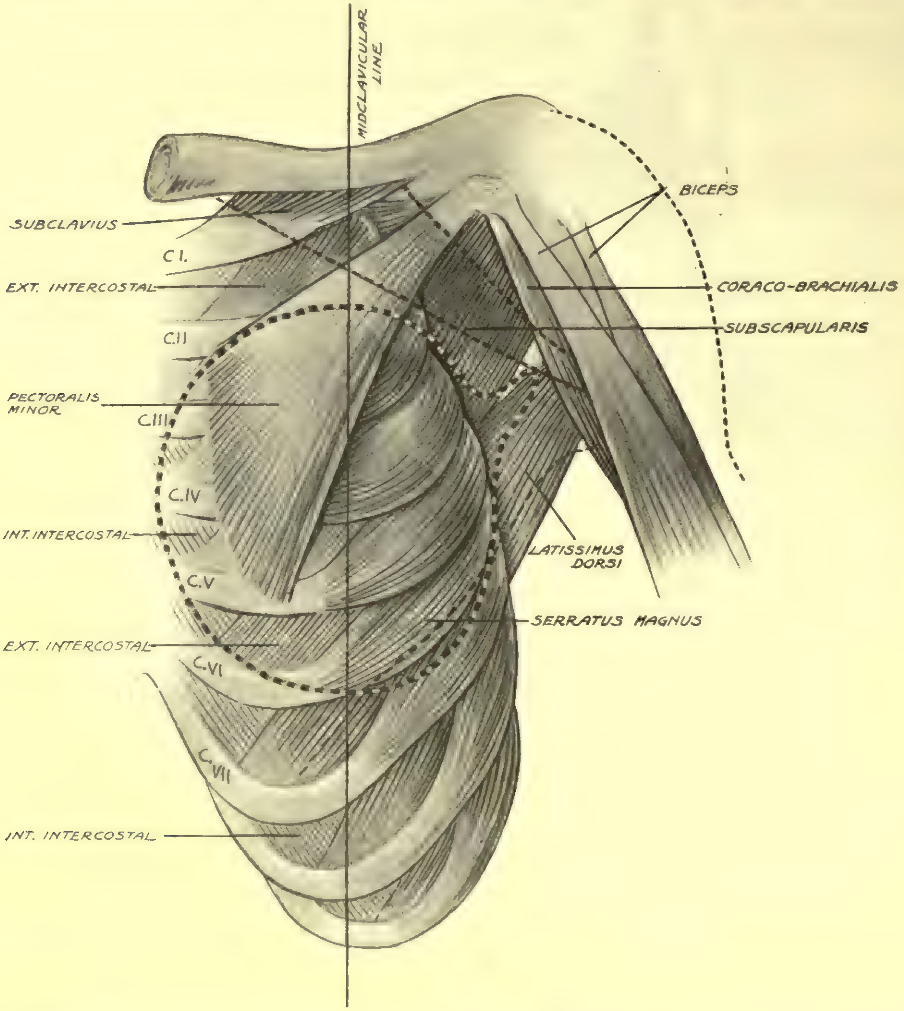

Fig. 2.—Diagram showing muscles underneath pectoralis major, the outlines of which are indicated by dotted lines. The area of the breast is indicated by the dotted circle.

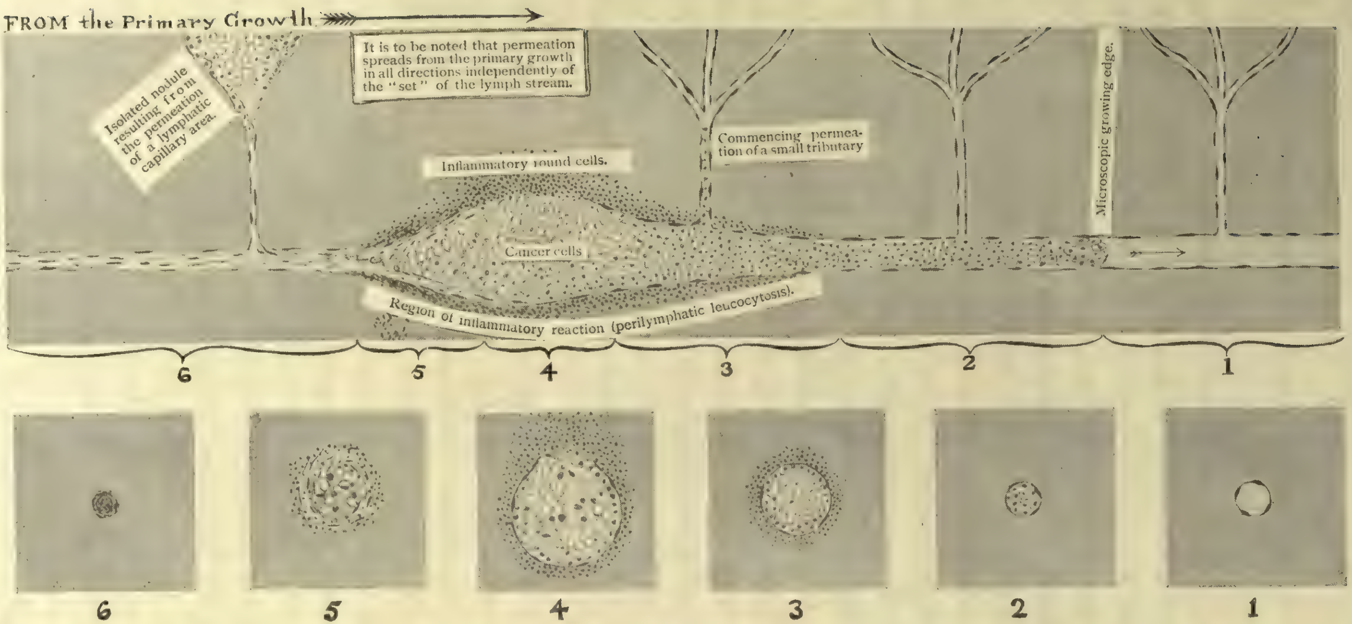
FROM the Primary Growth
It is to be noted that permeation spreads from the primary growth in all directions independently of the "set" of the lymph stream.
Isolated nodule resulting from the permeation of a lymphatic capillary area.
Inflammatory round cells.
Cancer cells
Region of inflammatory reaction (perilymphatic leucocytosis).
Commencing permeation of a small tributary
Microscopic growing edge.
6
5
4
3
2
1
6
5
4
3
2
1

FIG. 3.--Scheme to illustrate the advance of permeation along a small lymphatic, seen in the upper figures in longitudinal section, and in the lower figures as a series of transverse sections. The lymphatic is finally destroyed by perilymphatic fibrosis.

1. Normal lymphatic shortly to be invaded by permeation. 2. Lymphatic permeated by cancer-cells but not yet distended (note the absence of inflammatory reaction in this region). 3. The lymphatic distended by the growing cancer-cells; the central cancer-cells are becoming degenerate. 4. The lymphatic ruptured by the growing cancer-cells; an event followed by vigorous inflammatory reaction. 5. The mass of degenerate cancer-cells enclosed in a false capsule of newly formed fibrous tissue. 6. The cancer-cells are finally strangled by contraction of their fibrous capsule. The original lymphatic is now represented simply by a thread of fibrous tissue, the cancer-cells having been destroyed.

(From W. Sampson Handley's article on the Breast, from C. C. Choyce's *System of Surgery*.)

breast from the thoracic wall and removal of an innocent tumour through an incision on the deep surface of the gland, yet has the aesthetic value of leaving only a concealed scar.

Lymphatic Drainage.—In an organ so frequently attacked by carcinoma as is the breast, the arrangement of the lymphatics is necessarily a matter of vital importance to the surgeon. As Fig. 3 shows, the plane of the deep fascia is permeated by a complete system of branching and anastomosing lymphatic vessels which extends uninterruptedly over the whole body, but which is divided into a series of 'lymph-basins' each tending to drain primarily towards a special group of glands. The lymph-drainage of the anterior trunk-wall is separable into four great lymph-basins, two on each side of the middle line. Of these, that draining the area below the transumbilical plane flows towards the groin of the same side; whilst that from the upper part of the abdomen and from the thoracic wall passes mainly to the glands of the corresponding axilla. These lymph-basins communicate with their neighbours at their borders, but normally there is no tendency towards flow of lymph from one to the other; in disease, retrograde permeation and infiltration is, however, possible from one watershed to another, as will be seen later. As Handley has shown, the recognition of the essential unity of this great deep fascial plexus of lymphatic vessels is of great importance in explaining the transference of carcinoma to distant areas by permeation of cells, often against the normal direction of lymph-flow and along vessels too fine in calibre to permit embolism of cancer-cells (see p. 47).

The *intercellular* lymphatic spaces of the breast drain into small *intralobular* lymphatic capillaries; from these, vessels pass to the pectoral part of the deep fascial plexus. Sappey has also described a subareolar plexus just under the areola. Although the lymph-vessels of the 'pectoral plexus' communicate with those of adjacent lymph-basins, and also small lymphatics accompanying the perforating branches of the internal mammary artery pass to the retrosternal glands, normally the flow is either to the axillary or to the subclavicular glands. From the 'pectoral plexus' numerous vessels, large enough to permit passage of cancer-cells, pass to the glands on the inner wall of the axilla and thence to those in the apex of the axilla, in the subclavicular and in the supraclavicular regions. From the deep surface of the mamma a few vessels travel directly through the pectoralis major to reach the subclavicular glands without taking the axillary glands *en route*. Recognition of this fact will bring home to the surgeon the absolute necessity for a complete removal not only of pectoralis major, but of pectoralis minor, and for a radical clearance of the subclavicular fossa in every case of cancer of the breast. The relationship of the lymphatic drainage of the breast to cancer will be further discussed later (p. 47).

From the skin, lymph collects in the subpapillary plexus and thence passes straight inwards along the fibrous trabeculae of the subcutaneous tissue to the deep fascial plexus.

Development of the Breast.—Early in the second month of intra-uterine life, in the higher mammals, a crest or line of epiblast may be seen on each side of the ventral aspect of the embryo ; this line may be traced from the root of the upper limb to that of the lower, from the axilla to the groin. During the second month a series of little mounds, the mammary points, appear along this line, but in man, of these only one on each side remains and develops further ; the others atrophy, if they appear at all. At each mammary point the proliferating epiblast begins to grow down as a small rounded clump into the subjacent mesoblastic tissues.

During the third month the mesoblast, which provides the fibrous stroma of the gland, is still further invaded by small processes from the epiblastic clump ; these columnar processes are the parents of the main galactophorous ducts and of their glandular ramifications.

At about the sixth month the centre of the mammary area becomes raised, but the nipple is only fully developed at birth ; then from the epiblastic processes bulbous-ended ramifications are budded off to form the glandular tissue, and the central skin becomes raised round the developing ducts to form a definite nipple.

Physiological Changes of the Breast.—In the male and in the young girl the breasts are small, and the poorly-developed ducts end in small blind clubs instead of opening into definite alveoli composed of cubical cells.

At *puberty* in the female the main ducts bud off a number of hollow bulbs lined by the characteristic cubical cells ; in this way an acinous structure, more or less similar to that of the mature breast, is developed. Here and there, also, solid masses of epithelial cells surrounded by basement membrane are to be seen. These changes are usually accompanied by an augmentation of the interacinous and supramammary fibro-adipose tissue. At the same time there may be some swelling, a slight amount of serous discharge, tenderness, and even neuralgic pain (see under "Mastitis of Puberty," p. 16).

Changes during Pregnancy.—During pregnancy and lactation the mamma reaches the consummation of its evolution. The vascular supply becomes richer, the lobules are augmented in size and increased in number, and new acini are developed. Any mammary tumour that may be present at the same time shows a tendency to growth at an increased rate. After the completion of pregnancy and lactation involution occurs, the stroma becomes less vascular, and many of the acini disappear. At the same time an included tumour may share to some extent in the process of involution.

DEVELOPMENTAL ANOMALIES

The breast may be physiologically or anatomically anomalous; the normal secretion may be modified in quantity or in quality; or the organ itself be abnormal in number, shape, or volume.

I. Amastia and Athelia.—Non-development of one or both breasts constitutes *amastia*; absence of the nipple or nipples is known as *athelia*; the two conditions do not necessarily co-exist, but may do so, the site of the organ being unchanged and similar to the rest of the thoracic integument. In athelia the areola may be present or absent. Athelia without amastia is extremely rare.

Amastia is complete when both breast and nipple are lacking, incomplete when the nipple, with or without an areola, has developed; in the latter case the galactophorous ducts are unformed. One or both breasts may be affected; in the unilateral cases the single gland is usually well developed and capable of physiological activity.

Amastia may be the only deformity or it may be associated with other changes in the thoracic wall, such as localized absence of sweat glands, maldevelopment of the sternal part of the pectoralis major, or even gaps in the ribs or at the costochondral junctions. Associated genital anomalies such as absence of the ovary, rudimentary development of the uterus, etc., have been recorded, but these are very rare.

The periods of intra-uterine growth during which the arrest of development has probably occurred in these anomalous conditions will be readily understood by reference to the brief account of the origin of the mamma given on p. 7 above.

II. Polymastia.—This condition is a phylogenic reversion in which on the mammary line mammary points, additional to the normal human pair, reach a state of greater or less development, and give rise to one or more supernumerary breasts. Such organs usually possess a nipple, but are rarely, though occasionally, functional.

In polythelia the supernumerary nipples may be associated with supernumerary glands, but in some cases a normally placed gland may have more than one nipple; in this case the extra nipple may be placed on the normal areola (intra-areolar) or it may be situated outside its bounds and may then itself possess a separate areola: in either case, if the additional nipple be well developed, both nipples drain the whole of the breast.

The supernumerary breasts are naturally placed along the mammary lines from the axillae to the groins (Merkel), and have even been found in the upper part of the thigh, but they are usually below the normal mammae. Occasionally a single extra breast is found in the middle line near the umbilicus ; in this case the mammary lines of the two sides have been fused in their lower parts. Williams, however, held that the normal line ran from the axilla to near the umbilicus.

Very rarely breast-tissue has been found in entirely anomalous positions such as on face, back, and shoulder. Supernumerary breasts are rarely more than one or two in number, but in Neugebauer's case[1] there were eight, all functional. They occur more frequently in males than in females ; in 4000 people Mitchell Bruce found that 47 males and 14 females were affected.

Two independent conditions have occasionally been confused with polymastia. (*a*) An *aberrant lobule* of a normal breast may be attached to the rest of the gland only by a fine pedicle and may be mistaken for a separate gland. Such a lobule is placed usually near the axilla above or near the sternum below ; it is unattached to the skin and has no separate nipple. (*b*) A *false axillary supernumerary mamma* may appear during pregnancy and lactation. Champneys has shown that this is composed of the hypertrophied axillary sebaceous glands from which, in a few cases, a milk-like fluid may be squeezed by forcible expression. Such false mammae are widely adherent to the skin, have no signs of nipple or areola, and the fluid expressed from them by manipulation exudes from pores scattered over the tumour. Seitz held that these false mammae are altered sweat-glands.

The interest of the surgeon in these accessory breasts, whether true or false, is centred in the fact that they may undergo inflammatory or neoplastic pathological changes similar to those of the normally placed organs ; but he is also sometimes called upon to diagnose them from other conditions such as lipoma. Such a diagnosis may not be easy in the case of a supernumerary breast without nipple or areola.

Treatment.—Removal may be demanded when the accessory gland is the seat of neoplastic change, or when its presence in the axilla or groin causes chafing or interferes with free movement of the limbs. If cancer has supervened, the extirpation must be very free and include all neighbouring muscles, fasciae, and glands.

III. Malformations of the Nipple.—(1) The nipple may be well formed but too *short* to permit the child to grasp it; this fault can often be overcome by manipulation and by cold lotions to excite the erectile tissue by stimulating the areolar muscular fibres. If this treatment is insufficient, an artificial teat may be used.

(2) Less often the nipple is *umbilicated* ; although well formed it is so buried in a fossa that the child cannot reach it ; in mild cases manipulation during the

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[1] *Centralbl. für Gynäk.*, 1886.

later weeks of the pregnancy will advance the nipple from its depression ; in more marked cases the operation of mamilloplasty (Kehrer's operation) may be performed to prepare for the period of suckling ; this aims at effacing the depression and raising the nipple by removing a crescent of skin from each side beyond the base of the nipple, and then suturing each wound.

(3) Complete *invagination* is fortunately rare. The nipple is pulled so far in that it is turned inside out. Although occasionally a congenital condition, it is perhaps most often seen in elderly women with very pendulous breasts. In such case the nipple can often be made to present by raising the breast and pressing back the skin near the nipple with the fingers. It is essential that this be done regularly for the purpose of cleansing.

(4) Acquired retraction of the nipple is quite different from, and must be carefully distinguished from, the above-mentioned conditions ; it is most often due to cancer, though occasionally it may be associated with Paget's disease, with a dried-up cyst, or with the cicatrization following a mammary abscess (see under "Diseases of Nipple," p. 12).

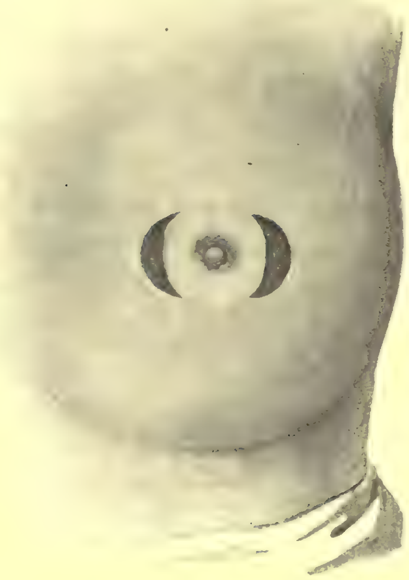


FIG. 4.—Mammilloplasty.

The elliptical areas from which skin has been removed are then closed and the nipple so raised.

IV. Mammary Atrophy.—Mammary atrophy is not synonymous with mere deficiency in size, for many flat breasts are functionally adequate ; it rather implies a combination of small glandular development with physiological incompetence. Its causes are somewhat vague—in some cases a pure developmental failure, in others it may be associated with past mastitis, cretinism, and infantilism, or possibly with the habitual non-suckling of children, with mumps, or with general tuberculosis. It is usually bilateral.

V. Mammary Hypertrophy in the Female. Diffuse hypertrophy of the breast is a rare condition involving chiefly the interstitial connective tissue, but also the glandular elements, especially in the cases associated with pregnancy.

The whole breast becomes indurated and may grow to an enormous size, so that when the patient sits down it rests on the thighs ; several breasts weighing from

15 to 20 pounds have been removed, and Durston (quoted by Labarrague and by Baumgartner) amputated a left breast weighing 64 pounds.

Although the condition may be more advanced in one breast than in the other, it is generally bilateral; unilateral hypertrophy may rarely occur, but it is then the surgeon's duty to consider the probability of a deep-seated and perhaps diffuse fibro-adenoma. Some writers indeed class diffuse hypertrophy as a neoplastic formation of the diffuse fibro-adenomatous type, though the histological characters vary within wide limits. The connective-tissue stroma is greatly thickened, the vessels enlarged, and the glandular tissue hypertrophied.

Etiology.—The true causation is unknown. The condition arises during two periods of sexual life, at puberty or during pregnancy. It has been stated that in the first case the hypertrophy affects chiefly the connective tissue and is steadily progressive, whilst in the pregnant woman true glandular hypertrophy may be present, and there is a tendency to subsidence after delivery.

In one or two cases, notably one of Kocher's, there has been a strong hereditary influence.

Clinical Features.—At the onset the breasts enlarge painlessly and remain globular and well-shaped. Later they become more or less pedunculated and fall on to the lower chest and abdomen, the skin gradually becomes reddened, open-pored, and perhaps a little oedematous, the nipple is indrawn, and the patient complains of a sense of dragging weight, and sometimes of neuralgic pains. In the later stages softening occurs unequally, and a jelly-like consistence develops in places. Eventually pain, dyspnoea, indigestion, sleeplessness, and even kyphosis may accrue and demand treatment by removal of the hypertrophied organ.

Prognosis.—The form associated with puberty progresses rapidly. Subsequent marriage may increase the rate of growth though it has been known to cause diminution (Delbet). The hypertrophy of pregnancy has a less serious outlook, for in many cases retrogression follows parturition. The hypertrophied gland is functionally useless.

Treatment.—In gravid women the breasts should be supported by bandages, and the patient kept at rest until the completion of term. In adolescents the breasts may be supported and compressed and menstrual irregularities combated, but usually with little result. Removal of the breasts becomes necessary for increasing pain and discomfort or for loss of general health; each breast should be removed at a separate operation.

INJURIES OF THE BREAST AND NIPPLE

Bruises, wounds, and burns of the nipple and surrounding skin are to be treated on ordinary surgical principles—they only derive importance from the possibility that they, or the scarring they cause, may interfere with lactation.

Bruises of the actual breast-tissue may give rise to a haematoma, which may become infected to form an abscess. Such infection is more likely to follow a bruise during lactation. Coley has adduced cases that strongly suggest an occasional etiological relationship between trauma and subsequent malignant growths, especially sarcoma, but there is no definite proof. Repeated traumata may be a factor in the production of chronic mastitis.

Wounds of Breast-Tissue.—A wound of breast-tissue usually heals readily unless a large duct be damaged. But if one of the galactophorous ducts be cut in a lactating woman, blood and milk escape, and the wound discharges milk at each attempt to suckle the infant. Such a wound exposes the patient to grave danger of the development of a mammary abscess or of a permanent lacteal fistula, and in any case takes a long time to heal. It should immediately be cleansed and sutured, and lactation should be stopped.

If a lacteal fistula forms, its edges should be cleansed, refreshed and sutured, and gentle local pressure applied. If all other means fail the affected wedge of breast may require excision.

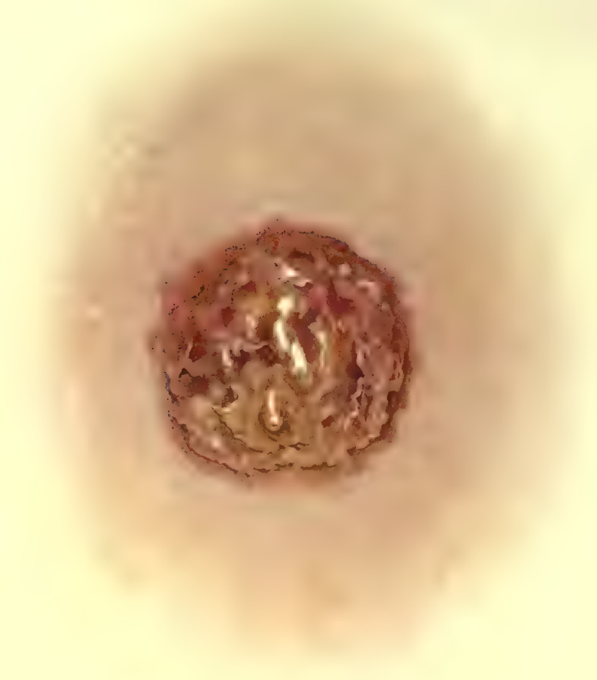
DISEASES OF THE NIPPLE AND AREOLA

Undue *shortness*, *umbilication*, and *invagination* of the nipple have been referred to above (p. 9).

Retraction is an acquired condition, usually due to carcinoma, though occasionally it may be due to the traction exerted by scar-tissue or by the shrivelling of a cyst; chronic mastitis does not cause retraction.

Fissures of the Nipple. Cracked nipples occur during lactation, often during the first week and especially in primipara, and are usually due to carelessness in allowing the nipples to remain wet with milk and saliva after the completion of nursing the infant. The epithelium becomes sodden, chafed, desquamated, and cracked, and the sensitive substrata inflamed. If the abrasion be neglected and irritated by continued suckling it may develop into a deep crevasse or into a definite ulcer. The fissure or ulcer may involve the areola. Infection may spread along the galactophorous ducts or by the lymphatics into the breast, there to cause

PLATE I. Vol. III



Paget's disease of the nipple, showing a yellow, viscid exudate
on a reddened surface

TO FACE PAGE 13

mammary abscess, especially as the pain discourages suckling from that breast, and therefore leads to milk-stasis.

Treatment.—(*a*) *Preventive.*—For some weeks before the birth of the child, the nipples should be prepared and hardened by bathing them with spirit or with equal parts of 90 per cent spirit and glycerine. During lactation cracks should be prevented by bathing the parts with boric lotion after nursing, followed by very careful drying, and the application of a plaque of dry sterile gauze. If drying is completed with difficulty, some inert, harmless hygroscopic dusting powder such as boric acid and starch, in equal parts, may be used.

(*b*) *Curative.*—If a fissure or ulcer has developed, any crusts present must be softened by the use of a compress and removed; then some active antiseptic should be applied, such as hydrogen peroxide, equal parts of alcohol (90 per cent) and glycerine, tinct. benzoini, or biniodide of mercury. These should be thoroughly washed off before giving the breast to the child; after suckling, the parts must be thoroughly washed again and a dry sterile dressing applied. If the cracks persist, teats may be necessary, or a rubber covering may be applied to everything except the apex of the nipple during nursing. Dryness is essential. Suspension of lactation may be necessary in very obstinate cases.

Eczema of the Nipple.—Simple eczema may occur in this region, as elsewhere on the skin. It may or may not be associated with lactation. In the latter case the staphylococci, which of necessity infect the eczematous patch, may spread along the galactophorous ducts, infect the milk, and cause a mammary abscess.

Dryness is as essential in the treatment of eczema as in that of cracked nipple, for the conditions are closely allied. The use of a glycerine and carbolic lotion, of boric ointment, or of *unguentum hydrargyri ammon. dilut.* will generally cause improvement. If suckling be in progress, weaning is usually necessary; if nursing be continued, no poisonous applications must be used.

Paget's Disease of the Nipple.—This condition may be confused with eczema of the nipple, but it is really a unilateral malignant dermatitis associated with carcinomatous changes within the breast. It affects middle-aged and elderly women, is rarely seen in young women or in men, and is very chronic and irresponsive to treatment.

Clinical Appearances.—The skin of one areola and nipple becomes inflamed without induration; usually it appears raw, bright red, smooth, or covered with fine granulations, and exudes a clear, yellow, viscid fluid in considerable amount (Plate I.). Occasionally it becomes crusted with yellow scabs; sometimes vesicles like those of eczema are seen; and comparatively rarely it mimics psoriasis by being dry and scaly. The patient may complain of itching and burning sensations, or may be free from subjective symptoms.

The disease is practically always followed by the development somewhere in the breast of an obvious carcinoma, either a scirrhus or a duct-cancer ; the tumour is not necessarily in the neighbourhood of the nipple, and may not be palpable for some years.

Pathology.—According to Butlin and to Handley, there is vacuolation and swelling of the cells of the deeper epidermic layer, small round-celled infiltration of the corium, in the subcutaneous tissues and around the ducts, and dilatation of the galactophorous ducts, which become blocked with epithelial *débris*. Epithelial outgrowths may fill the lumina of some of the smaller ducts and acini, or may invade surrounding tissues.

Relationship to Cancer.—As already stated, a palpable cancer is sooner or later to be found in the affected breast, perhaps at a distance from the nipple. The growth may be a columnar-celled carcinoma of the ducts, or even an epithelioma of the nipple itself (Butlin), but most frequently it is a spheroidal-celled acinous carcinoma, which is so fibroid as to be a scirrhus, or even an atrophic scirrhus. Paget described the eczematous condition as a precursor of the cancer, but it now appears that it is really secondary, the cancer not yet having been discovered in the early stages ; the comparative frequency with which the accompanying neoplasm is an atrophic scirrhus explains the relative chronicity of the disease and the difficulty often experienced in localizing the growth. The manner in which the eczematous change is produced has not been fully determined. Thin believed that it was due to irritant discharge from the nipple, but the cancer is often acinous and without external discharge. Handley holds that it is caused by interference with the lymphatic return from the nipple region, the most dependent part in elderly women, owing to cancerous permeation of the local lymphatic vessels followed by their fibrotic obliteration (see later under "Cancer of the Breast").

Diagnosis.—The clinical features, the bright red colour, the invariably unilateral distribution, the failure of the ordinary treatment of simple eczema, will induce a strong suspicion of malignancy. If, in addition, a cancerous tumour can be found in the mamma, the diagnosis is confirmed.

Treatment.—The whole breast, with a wide area of skin and with the underlying muscles, must be removed and the axilla cleared, just as in cancer of the breast (see p. 61). If no tumour is obvious, but the eczema is very chronic and resistant to treatment, it is a justifiable and safe plan to assume the presence of an impalpable scirrhus and to operate accordingly.

The *prognosis* is that of the associated carcinoma, and depends therefore on the earliness and thoroughness of the operative treatment. Inasmuch as the cancer is often an atrophic scirrhus, the outlook is then correspondingly good.

Chancre of the Nipple and its Surroundings.—As the result of the suckling of a syphilitic child by a healthy woman, a primary sore may develop on the nipple, on the areola, in the fissure between the nipple and areola, or, less frequently, on the skin of the breast. By Colles's law the mother of a syphilitic child is safe from infection by her own offspring, probably because she has herself suffered a mild and perhaps undetected infection. Usually only one chancre is present, but several may be seen, and a bilateral distribution is not very uncommon. The sore may show the usual Hunterian characters, but, as is often the case with extra-genital chancres, it may present considerable departures from the typical appearances. It may take the form of a shallow ulcer with raised edges and well-marked induration of the surroundings ; but not infrequently it is merely a non-indurated but very persistent fissure or erosion with a scanty discharge ; occasionally it presents a grey or reddish varnished surface. A chancre in the groove between areola and nipple may be crescentic, and has been known to amputate the nipple. Phagedenic changes may develop, but are fortunately rare.

The glands draining the breast, especially those in the axilla, become firm and palpably enlarged, but remain mobile and are not tender.

In doubtful cases the *diagnosis* can only be made with certainty by the appearance of secondary signs, by the discovery of the *Spirochaete pallida*, by the Wassermann reaction, and perhaps by Noguchi's luetin test.

The *treatment* is that of syphilis generally, a judicious admixture of several intravenous injections of salvarsan or neo-salvarsan with mercury given by intramuscular injection, by inunction, and perhaps by oral administration.

Papilloma of the nipple is occasionally seen. The smaller examples present the usual warty appearance, but large ones of long duration tend to become pedunculated, perhaps to a considerable degree. Each papilloma should be excised.

Sebaceous cysts of the nipple and areola are rare, but may occur ; they are best treated by excision.

Carcinoma may originate in the nipple, but is rare. It usually adopts the epitheliomatous type, ulcerates early, and invades the breast. It calls for the radical excision of the breast.

MASTITIS

The breast is frequently the seat of acute or chronic inflammation, the acute variety often proceeding to suppuration and abscess-formation. Usually the glandular tissue itself is attacked, but a chronic interstitial mastitis is seen in women near the menopause. Paramammary abscesses, such as the supramammary and the retromammary varieties, will be considered after intramammary abscess inasmuch as they often arise independently of the gland itself.

A. Acute Mastitis and Intramammary Abscess.—Acute inflammation especially tends to affect the breast during periods of sexual development and physiological activity such as puberty, pregnancy, and the puerperium, but it may also be seen in non-puerperal women, and in the new-born.

Varieties.—(*a*) The *mastitis of puberty* may occur in either sex. In adolescents the breasts often show some swelling, hyperaesthesia and perhaps para-aesthesiae; if at this time the organ is irritated by the friction of clothes or by injudicious rubbing, and organisms gain access to the congested gland, definite mastitis may result, and may even proceed to suppuration. At the same time the follicular glands of the areola may be swollen and inflamed. The patient, already mentally disturbed by the phenomena of puberty, is often excessively worried and needs reassuring.

(*b*) and (*c*) The *mastitis* of the later months of *pregnancy*, and that associated with *lactation* are closely allied. The breasts are congested and active, first undergoing the developmental changes already described, and then forming and secreting milk; they therefore readily become inflamed if subjected to the attack of organisms arriving in the gland by the blood, by the lymphatic vessels, or, as is more usually the case in the mastitis of lactation, from an infected abrasion or fissure of the nipple by the ducts. In many puerperal cases milk-stasis and engorgement is a strong predisposing cause; one or more of the ducts become blocked with epithelial *débris*, and the secretion is retained; the lobe becomes hard and tender, and contains an excellent culture medium for the growth of any attacking organisms. As a result, acute mastitis develops in the affected lobule or lobules, and may resolve or may suppurate. Acute mastitis in association with lactation is usually unilateral, and is more prone to occur in a primipara than in a multipara; most cases arise during the first month after accouchement, but the incidence rises again at the end of suckling; women who have, for any reason, to suspend nursing prematurely are especially liable. The mastitis of pregnancy usually appears during the last three months.

(*d*) In *non-puerperal women* acute mastitis may develop in connection with mumps after the subsidence of the parotid swellings; this form usually resolves without suppuration, but atrophy of the affected lobules may follow. A localized mammary abscess may arise after an injury or in association with pyaemia, or with typhoid fever; occasionally the breast-involvement is secondary to pyogenetic infection of neighbouring tissues such as ribs, pleura, or retromammary areolar tissue.

(*e*) *Mastitis neonatorum.*—In the new-born some swelling and congestion of the breasts is almost normal about the third to the sixth day after birth; the breast becomes knobby, rather tender, and perhaps slightly reddened. Usually this subsides in a day or two, but friction by clothes or misguided manipulations of ignorant nurses in "breaking the breast strings," may determine the onset of a definite mastitis or even of an abscess. The organisms probably enter from the nipple by the ducts or the lymphatics. This form of mastitis may attack one or both breasts in either sex.

Etiology.—The *active* cause in all cases is the ingress of micro-organisms, usually from the region of the nipple. The lobular distribution is explained by the fact that the ducts provide the commonest channel of entry, but in some cases the organisms are blood-borne or travel by the lymphatics.

Among the *predisposing* causes may be mentioned the congestion associated with physiological activity, milk-stasis, want of cleanliness, cracks and fissures of the nipple, meddlesome manipulations, and depreciation of general health.

The organisms most frequently found by Benians[1] belonged to the order of *Staphylococcus pyogenes aureus*, sometimes in pure culture, occasionally mixed with streptococci, or less often with *Staphylococcus albus*.

Clinical Features.—(*a*) Of *Acute Mastitis before Suppuration.*—When, owing to the blocking of ducts or to the weaning or death of the child, the secretion accumulates in the breast, localized or general milk-engorgement ensues. In the latter case both breasts become diffusely swollen and tender, but may be relieved by artificial removal of the milk; unilateral diffuse engorgement is commonly due to failure to suckle on that side owing to retraction of the nipple, but is usually overcome if the breast is carefully emptied by the breast-pump, or by the child suckling through an artificial teat. If mastitis supervenes upon diffuse engorgement one or more lobes are first infected, and can be felt as indurated, tender, knobby, sector-shaped swellings in the turgid breast. In cases due to blocking of ducts either by epithelial *débris* or by cicatricial bands, the engorgement has a lobular distribution from the beginning.

Pain varies in degree, but may be acute; a throbbing character suggests that suppuration has begun. The axillary glands become palpable and tender, and constitutional symptoms such as malaise, loss of appetite, and fever (even up to

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[1] *Brit. Med. Journ.*, April 15, 1911.

104° F.) appear. Subsidence and resolution may then occur or suppuration may ensue.

(*b*) *Intramammary Abscess.*—When an abscess forms in the affected lobules, the patient looks obviously ill, the temperature rises further, the pain is increased and becomes throbbing, tenderness is marked, and the whole breast becomes oedematous. The overlying skin is flushed, and later becomes purplish, softens and bursts, perhaps at several points. Fluctuation is not manifest until late owing to the depth of the purulent collection during the earlier stages ; by the time it is readily elicited the pus has probably burrowed extensively through the gland. Unless adequate treatment is adopted the gland is left riddled with sinuses ; in weakly patients diffuse cellulitis of the chest wall and even local gangrene may occur.

The *prognosis* depends on the early application of suitable treatment. In favourable cases the mastitis subsides leaving the gland practically unimpaired ; in others suppuration does not occur, but the affected lobule develops chronic mastitis. If an abscess is diagnosed and opened early, the rest of the breast may remain useful, but if it be neglected and allowed to burst, much of the gland may be destroyed. In severe cases the organ remains as a sinus-riddled remnant requiring ablation before healing can be secured ; in the worst cases cellulitis or gangrene jeopardizes the life of the patient.

Treatment calls for alertness to decide the moment at which pus-collection begins. Although an abscess must be opened at the earliest possible moment, it is unwise to incise a mastitic lobule unless suppuration is present. This, however, is a less faulty procedure than postponing incision too long.

(*a*) *Before Suppuration.*—The part should be put at rest by supporting the breast by means of a bandage, and by fastening the arm to the side to prevent movement of the pectoral muscles. The breast-pump should be gently used to reduce tension, and measures taken to stop the secretion of milk. The child must be weaned. Hot fomentations are useful, and Bier's method of passive hyperaemia is of great value. A large bell-glass just smaller in diameter than the breast is applied, and the bell is exhausted until the breast rises up into it blue and congested ; the glass is used for from twenty to forty minutes daily, in alternating periods of exhaustion and release each lasting five minutes. The whole process must be painless ; pain indicates too great a suction. This method either hastens resolution or in some cases, when pus is developing, determines its formation towards the surface ; if pus has actually formed, an incision must be made at once. If the offending organism is definitely determinable, the use of an autogenous vaccine may prove useful ; my experience of their use has left me doubtful of their value in acute mastitis.

(*b*) *When suppuration has occurred*, early incision is necessary. The cut must be made in a direction radiating from the nipple in order to avoid division of ducts; it must be free, and must drain the whole collection; it is a good plan to introduce the finger through the incision and to break down all septa between different parts of the abscess to secure free drainage; in some cases more incisions than one are necessary. Under no circumstances must the abscess be left to point spontaneously and to burst into fomentations.

If Bier's congestion is employed, and if the abscess is diagnosed reasonably early, an incision of less size may be used, but careful watch must be kept to prevent pocketing of the pus. In the chronically persisting cases with many sinuses, treatment with a vaccine containing the *Staphylococcus pyogenes aureus*, and, if necessary, other organisms found in the pus, often proves of value. In very persistent cases, when the breast is riddled and useless, removal of the whole gland may be necessary. In all stages the general health must be improved by plentiful fresh air, by nourishing, digestible diet, by attention to the bowels, and by the exhibition of tonics.

B. Supramammary or Subareolar Abscess.—Pus collects just under the areola, superficial to the gland proper. The abscess is small and obvious, constitutional symptoms are slight, and an early, free, radiating incision readily leads to healing.

C. Retromammary Abscess.—Although usually an intramammary abscess points forwards, it sometimes bursts in the areolar tissue beneath the breast, and there causes a large abscess. Similar infection of the retromammary tissue may follow tuberculosis, osteomyelitis, or typhoid periostitis of a rib, or may result from a neglected empyema, or the infection of a retromammary haematoma. Occasionally a tuberculous retromammary abscess results from the tracking of ' pus ' along a rib from a diseased vertebra. The purulent collection is usually large so that the breast is pushed forward as a whole, cushioned on a bed of pus. The skin over the mamma is unaltered, but pointing tends to occur in the submammary sulcus.

Treatment consists in making a free opening in the submammary sulcus below the infero-external quadrant, in the surgical treatment of any discovered cause, and in efficient drainage; if, however, the abscess be a pure tuberculous one, emptying of the abscess should be followed by accurate closure, for in such case drainage leads to contamination with pyogenetic organisms and to persistent sinuses. If the infection has come from an intramammary abscess, a finger should be passed into its cavity, septa broken down, and the mammary abscess also drained through the retromammary tissue.

D. Chronic Mastitis.—Chronic mastitis is relatively common, especially in women near the menopause, and is of considerable importance because it is often difficult to diagnose from carcinoma, and because it is sometimes a precursor of that disease.

Pathology.—Although not rare in younger women, its incidence is especially marked in the years just before the menopause. In some cases the relationship to a blow or to repeated small traumata is sufficiently close to justify a belief in their causative agency ; in others imperfect involution after lactation, a previous attack of acute non-suppurative mastitis, infection with attenuated organisms, or the blocking of ducts by scars or by a tumour, such as a fibro-adenoma or a duct papilloma, seems to be an etiological factor.

Macroscopic Appearances.—The whole breast may be involved, but not infrequently a lobe, or series of lobes, is alone attacked, and the indurated mass may then be wedge-shaped. On section the diseased part cuts with a resistant, rubbery sensation, but lacks the stony hardness and inelasticity of a scirrhus. The cut surface is faintly pinkish or yellowish white, whereas a scirrhus is often greyish. In old-standing atrophic cases the affected part of the breast appears much shrunken.

Involution cysts containing a clear or brownish fluid are often present ; in most cases they are small, although one or two may be large and firm enough to cause much difficulty in the diagnosis from a tumour. Sometimes, however, cyst-formation is excessive, and the breast is converted into a mass of cysts, some of which are of considerable size. This latter condition is known as *cystic disease of the breast*, and by some writers has been classified among the neoplasms ; it is, however, merely an exaggeration of the changes commonly seen in chronic mastitis.

Chronic mastitis is frequently bilateral, especially in women approaching the menopause, but it may be more advanced in one breast than the other. Although it may affect the whole or any part of the gland, it most frequently attacks the axillary tail and the supero-external quadrant.

Microscopic Appearances.—The primary change seems to be in the connective tissue ; this becomes thickened and more cellular ; at the same time it is more or less infiltrated by small round cells. In the later stages a progressive fibrosis squeezes and largely destroys the glandular elements and fat. All the connective tissue is involved, both peri-acinous and interlobular. According to the changes seen in the acini themselves two types of chronic mastitis have been described, viz. the hypertrophic and the atrophic, but probably the latter is merely a sequel of the former.

The *hypertrophic* variety is characterized by epithelial proliferation, and by an increase in number of the acini and in the size of the lobules ; the acini are then often filled with curdy material which may occasionally be expressed through the nipple.

In the *atrophic* type the fibrous tissue has become sclerosed, and the acini are largely obliterated. A few acini survive, but with degenerate epithelium, and with lumina often blocked with *débris.*

In *chronic cystic disease* the breast is converted into a mass of cysts separated by strong fibrous tissue; the cysts contain no intracystic growths, but are filled with a clear or blood-stained fluid shut in by the interstitial sclerosis.

With chronic mastitis, a *neoplasm* may co-exist. Carcinoma is especially liable to develop in such breasts; moreover, fibro-adenomata and duct-papillomata are often associated with an area of mastitis, which has probably resulted from duct-obstruction.

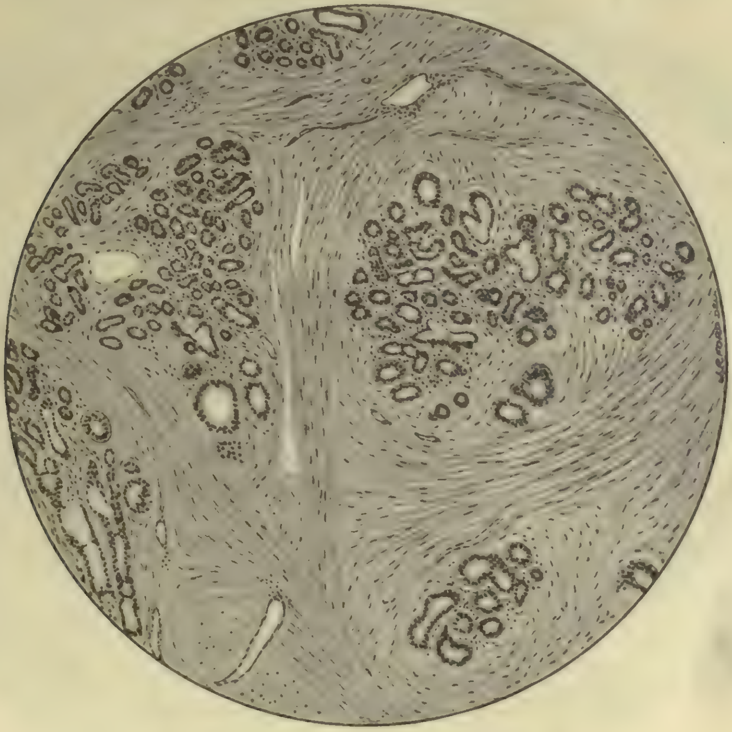

FIG. 5.—Chronic mastitis. Atrophic form.

Clinical Features.—Frequently no subjective symptoms are observed until a lumpiness is found by accident, but in some cases attention is attracted by pain, either of a dull aching or of a sharp, intermittent, neuralgic character. The pain may be exaggerated at the menstrual periods or by any movement of the breast on the subjacent structures.

In some cases in which the ducts are incompletely blocked, there may be a small amount of thin serous discharge from the nipple, especially when the breast is squeezed. On inspection the organ may appear enlarged and in cystic cases even knobby; in the markedly atrophic cases seen in women near their menopause, the whole breast may be much contracted, and form a concave disc, with a diameter smaller than that of the normal breast, with thickened edges, and with the nipple as its centre. Retraction of the nipple or adhesion of the skin to the breast should cause a grave suspicion that carcinoma has already supervened.

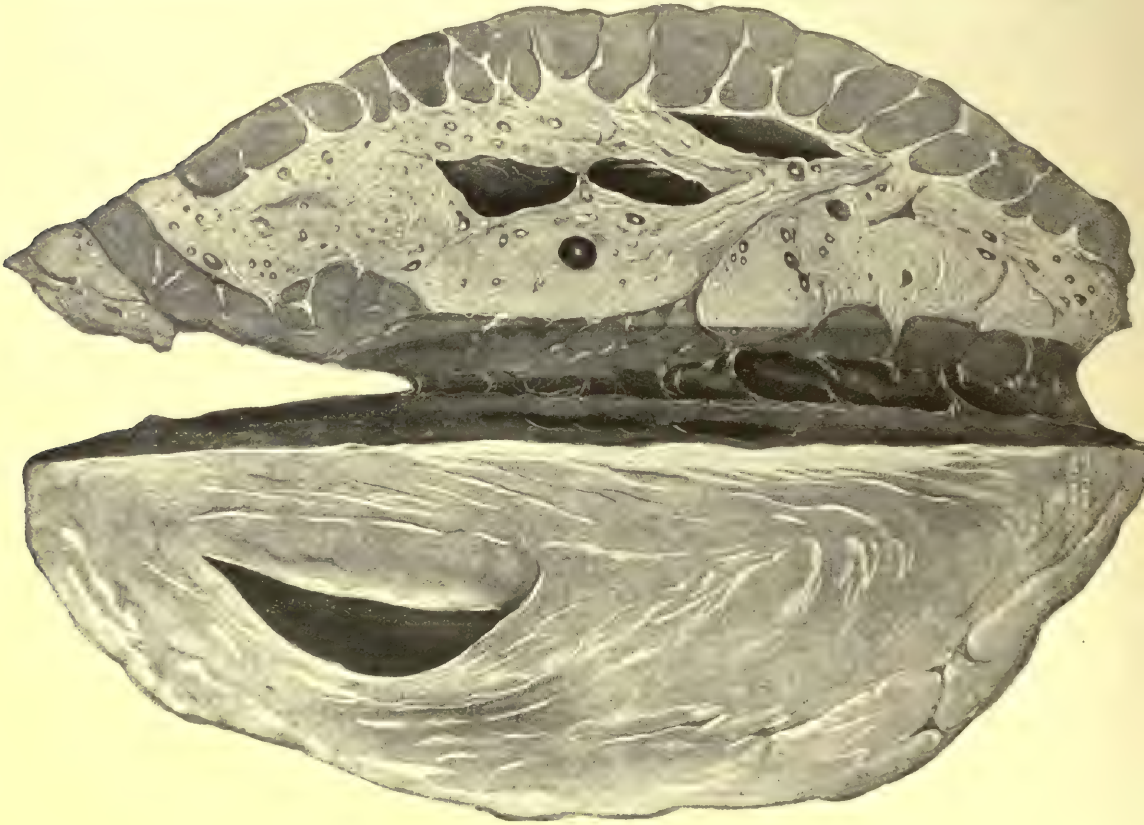

FIG. 6.—Chronic mastitis with multiple cysts.

On palpation, the breast feels granular and of a rubbery consistence. When the organ is picked up between the fingers and thumb a definite lumpiness can be felt, which, however, in uncomplicated cases is no longer obvious when the breast is palpated between the flat palm of the observer and the chest-wall of the patient. But when cysts are present they can be felt as more or less elastic lumps even with the flat hand. A firm mass palpable even with the flat hand in a chronic mastitic induration is probably either a very tense cyst, a fibro-adenoma, or a carcinoma associated with the mastitis. When only a part of a mamma is involved a sector-shaped arrangement can often be made out; as Handley[1] points out, this distribution then serves as a valuable diagnostic sign. The axillary glands are often unduly palpable, firm, and tender, but are not so hard as those associated with carcinoma.

Diagnosis.—The diagnosis of chronic mastitis from carcinoma is of great importance, and may be very difficult, especially when it is remembered that the two diseases may co-exist. In simple cases the clinical characters described above suffice for differentiation. In chronic mastitis the whole breast is more or less affected, or if only a part be involved, it is frequently a wedge-shaped area corresponding to one or two lobes; carcinoma on the other hand attacks only a part and shows no respect for the normal trabeculae partitioning the mamma into sectors. In chronic mastitis the breast is not adherent to skin or pectoral fascia, and the nipple is not retracted.

The mass feels rubbery or leathery but not stony hard, and in cases uncomplicated by cysts, co-existent carcinoma or fibro-adenoma is not felt by the flat hand. If cysts are present, they feel more or less elastic. In carcinoma simultaneous involvement of the second breast very rarely occurs, except as a very late spread from the primary carcinoma (see later); chronic mastitis on the other hand frequently affects both mammae. In chronic mastitis sometimes two or more separate masses may be felt in the same breast; carcinoma almost always forms one continuous lump.

The axillary glands in cancer are enlarged early, are hard and painless; in chronic mastitis, if enlarged at all, they are less hard, usually less obvious, and frequently tender.

Many of these differentiating signs are, however, confused when isolated, firm cysts are present in an inflammatory mass, or when carcinoma and mastitis co-exist. In all cases of doubt an exploratory incision should be made; sometimes the macroscopic appearances of the section are characteristic (see above, p. 21), and settle the diagnosis, but often removal of a piece for microscopic examination is necessary. This may be made at once in a few minutes by Ernest Shaw's plan of examining a frozen section, and, if necessary, the complete removal of the breast may be proceeded with. If, however, the pathologist be unfamiliar with the appearances seen in frozen sections it is safer to give him time for his ordinary section-cutting methods. In my opinion the danger of stirring up such rapid growth by the incision as to make a few days' delay in operation dangerous, has been exaggerated.

Prognosis.—The condition may remain almost unchanged for years, or chronic cystic disease of the breast may develop, or the breast may atrophy and be converted into a firm but shrunken mass of fibrous tissue. Sometimes, however, carcinomatous changes occur, especially in patients near the menopause. There is much evidence, both clinical and pathological, to prove that many cases of carcinoma have shown precedent mastitis. Therefore a patient with mastitis must be kept under close observation.

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[1] "Breast," in Choyce's *System of Surgery*, vol. ii.

Treatment.—If the patient be young and the mastitis not far advanced, many cases are much improved by non-operative measures such as support of the breast, prevention of injury by clothing, etc., the local use of belladonna paint or ointment (especially in painful cases), of iodine or of *linimentum saponis cum pot. iod.*, or the application of Scott's dressing (strips of lint smeared with *ung. hydrarg. comp.* and strapped on to the part by means of firmly but evenly applied strips of plaster strapping). Scott's dressing combines the measures of even pressure, support, and gentle counter irritation ; in my experience it has been valuable. Handley has in a few cases secured improvement from exposure to the X-rays. In older women, especially those approaching the age of degeneration, and in cases of extensive cystic changes, operative measures are advisable. After a preliminary incision into any suspected area to determine the absence of carcinoma, either the whole breast or, in more localized cases, the wedge-shaped and indurated part should be removed ; the skin, muscle, and axilla are left untouched.

E. Tuberculous Mastitis.—Tuberculosis of the breast is comparatively rare ; it may take one of four forms, viz. :

(*a*) Multiple small tubercles.
(*b*) Diffuse tuberculous mastitis.
(*c*) Chronic encysted abscess.
(*d*) Tuberculous retromammary abscess.

(*a*) *Multiple Tubercle.*—This form may appear as part of a general miliary tuberculosis ; it requires no special description for the mammary involvement is a mere accident in the course of the general disease.

(*b*) *Diffuse Tuberculous Mastitis.—Pathology.*—Tubercle bacilli may reach the breast by direct extension from local disease in the neighbouring pleura, or ribs, and probably from tuberculous axillary or subclavicular glands, or they may be blood-borne from lesions in the lungs or elsewhere ; they settle in the interacinous connective tissue, and cause there the usual changes ; tubercles form and fuse into granulation tissue, masses of lymphocyte-like cells arranged around the acini ; then the acinous epithelium disappears, the nodules enlarge and giant-cell systems are often formed (Fig. 7). Such a nodule may now undergo fibrosis, or may caseate in the centre, whilst at its periphery fibrosis occurs to a greater or less extent. If the surrounding fibrous-tissue formation be sufficient to shut in the softened centre, a tuberculous *encysted abscess* results ; but in the ordinary *diffuse tuberculous mastitis,* the softened areas coalesce to form a series of tuberculous abscesses through the breast. These enlarge and come to the surface, often at many points ; there, bursting, they give rise to discharging sinuses which may riddle the gland in all directions.

Clinical features of diffuse tuberculous mastitis: one or more scattered areas of induration appear and enlarge until they become definitely palpable not only with the fingers, but with the flat hand. Each mass tends to cause local adhesion to the pectoral fascia and to the overlying skin, which may then develop a localized orange-rind appearance (Fig. 8) ; then it softens centrally, points, and bursts. The resultant sinus is lined with pale unhealthy-looking granulation tissue, exudes a mixture of caseous *débris* and watery ' pus,' and is very intractable. If the nodules have been numerous, the mamma is converted into a useless, sinus-riddled mass. The condition is nearly always unilateral, even in the later stages.

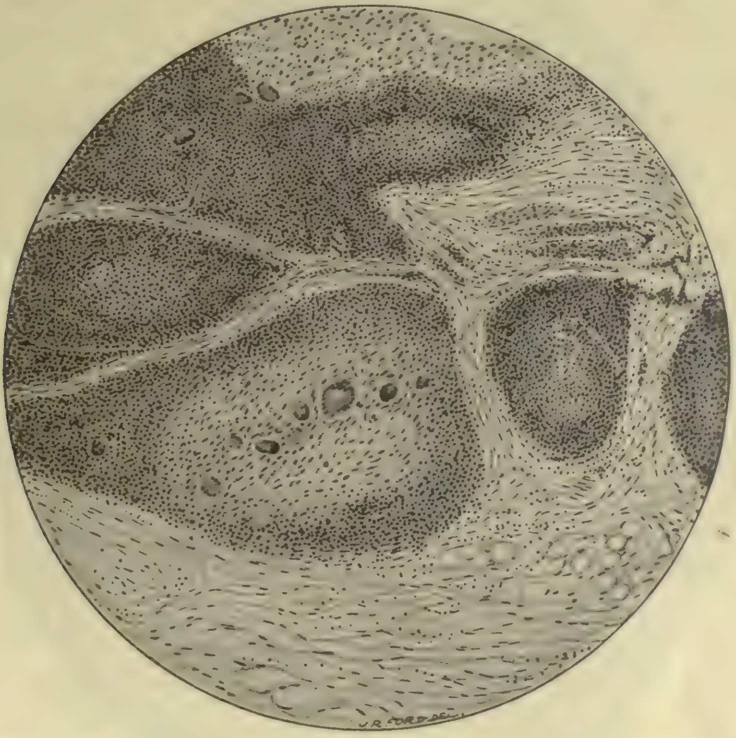

Fig. 7.—Tuberculous mastitis showing typical miliary-tubercle formation with giant-cells, etc. (From Cuthbert Lockyer's specimen.)

(*c*) *Chronic Encysted Tuberculous Abscess.*—Although a chronic encysted mammary abscess may also be due to staphylococci and other organisms, it is most frequently tuberculous in origin and is formed in the manner described above.

A thick-walled abscess may give no sense of fluctuation, although it usually feels softer near the centre than at the margins. It forms a firm mass with edges tailing off into the mammary tissue; the overlying skin may be adherent, and the axillary glands are often enlarged. If it be the only tuberculous manifestation diagnosis from a tumour can sometimes only be made by aspiration or by incision.

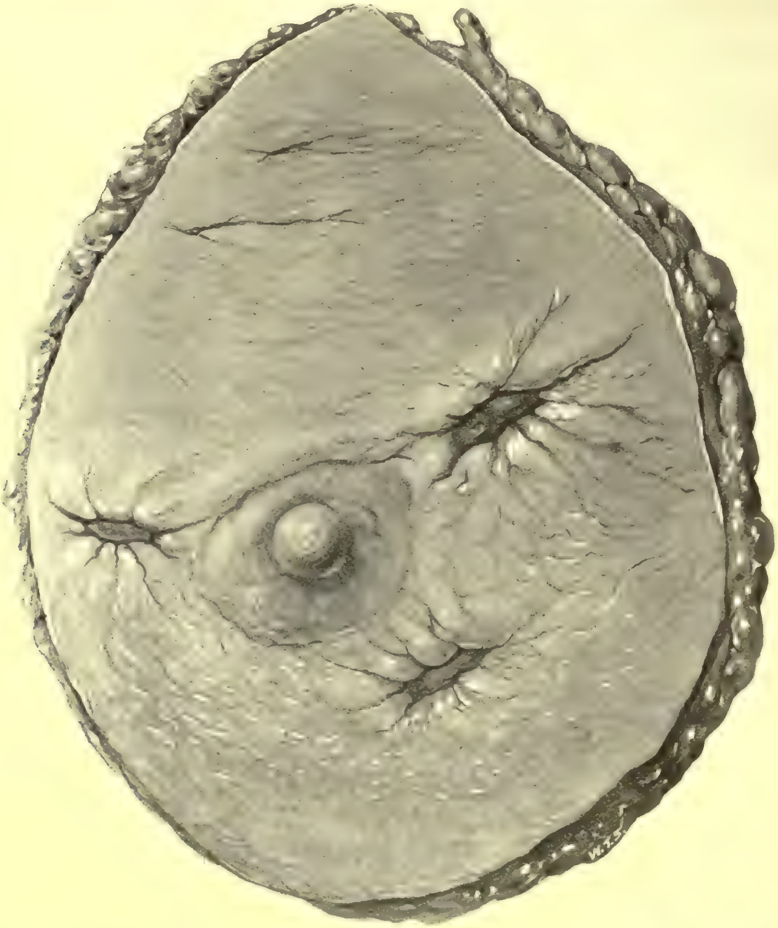

Fig. 8.—Tuberculous breast. (Museum of The Seamen's (Dreadnought) Hospital.)

(*d*) *A tuberculous retromammary abscess* is usually associated with costal, pleural, or, more rarely, vertebral disease. It presents the usual signs of a retromammary abscess (see p. 19), is chronic in course, and may invade the breast-tissue itself.

Treatment of Tuberculous Mastitis.—Although a few cases of tuberculous mastitis in the earlier stages will definitely improve after Bier's treatment by congestion, combined with aspiration of any abscesses present, the condition usually calls for operative treatment. A chronic encysted abscess may be opened, cleansed, filled with an iodoform and petroleum emulsion,[1] and closed again by means of Michel's clamps which suture the skin-incision without forming a track for secondary infection from the skin. If, however, as is often the case, the collection refills, it may be re-opened, again purified, and lightly packed so as to encourage healing from the bottom.

Ordinary abscesses in a diffuse tuberculous mastitis may be similarly treated if they are few in number and have not yet burst. If sinuses are already present, but are few in number, they may be enlarged, gently scraped, and cleansed. As a rule, however, in the later cases where the gland is riddled and useless, by far the most satisfactory treatment is to remove the whole breast with any enlarged axillary glands. A *retromammary* tuberculous abscess is to be treated on the lines already indicated (p. 19).

Prognosis.—Tuberculous mastitis if inadequately treated will persist almost indefinitely, the sinuses will become doubly infected, and ultimately amyloid disease of the kidneys and other organs may supervene. After removal of the breast the outlook is quite good unless tuberculosis be active elsewhere.

Actinomycosis of the Breast.—The streptrothrix of actinomycosis may reach the breast from the nipple, from a skin-abrasion, by direct spread from the pleura or chest-wall, or by metastasis from some distant focus in the neck, the tonsillar or caecal regions, or elsewhere. As is its wont, it primarily spreads in the connective tissues of the part, causing either a diffuse induration due to infiltration with granulation tissue, or a definite rounded granulomatous lump. Softening occurs usually in several places simultaneously, the skin becomes a reddish purple, and the characteristic actinomycotic discharge exudes through several points. This at first consists of a viscid, clear, or turbid fluid in which are suspended the typical ' red pepper ' or ' iodoform ' granules, which on microscopic examination after gentle teasing under water display the ' ray fungus.' Soon secondary infection with pyogenetic organisms occurs, and the multiple sinuses then discharge a true pus. The affected part of the organ is changed into a dense fibrous mass riddled with many sinuses. The axillary glands are neither palpably enlarged nor tender until pointing and secondary pyogenetic infection have occurred.

As is frequently the case with actinomycosis, the disease, whilst it spreads in parts, shows a tendency to die out in others, leaving a scarred mass of firm fibrous tissue. Occasionally it is difficult to find the ' pepper granules,' and recourse must be had to cultivation ; it must then be remembered that the streptothrix of actinomycosis is probably not always identically the same ; some families grew best in aerobic,

[1] Iodoformi ʒi, lanolini ʒi, petrolei ad ℥i.

others in anaerobic conditions, some on one culture medium, others on others, and that growth is often very slow so that the culture experiment may appear to be negative even for two or three weeks, and yet eventually succeed.

Prognosis.—If the disease be localized the prognosis is good under proper treatment ; it is proportionately worse if the lesion be secondary to disease in important tissues elsewhere.

Treatment.—Surgical measures, such as curetting of the sinuses, excision of the mass, or, better, removal of the breast, should be combined with the exhibition of massive doses of the iodides. Frequently no beneficial effect is seen until 40 grains of potassium iodide are administered thrice daily, and on several occasions I have found it necessary to give 100 or more grains three times a day ; if such large doses are given the patient should be given much fluid and plenty of food and fresh air.

In some cases the simultaneous administration of chlorine water in order to secure the liberation of nascent iodine in the tissues appears to exalt the effects of the iodides. As a local antiseptic, iodine lotions are of value, and in the case of the *streptothriciae* with anaerobic tendencies, hydrogen peroxide may be used with advantage.

Syphilis of the Breast.—The primary sore may be situated on or near the nipple (see p. 15), and the skin of the breast may share in the dermatological manifestations of secondary syphilis ; condylomata may be found in the moist sulcus below a large mamma.

In the tertiary stage, a diffuse unilateral gummatous infiltration may occasionally involve the breast. More usual, but still uncommon, is the localized mammary gumma. This forms a rounded mass, palpable with the flat hand ; eventually the skin becomes adherent, and may show an orange-rind appearance ; the nipple is occasionally retracted. The swelling increases in size, the overlying skin reddens, becomes purple and gives way, permitting the escape of a purulent discharge ; the resulting ulcer shows a characteristic wash-leather slough.

The diagnosis is made by the history, by the presence of syphilitic manifestations elsewhere, by the Wassermann reaction and luetin test, and by the success of antisyphilitic remedies. When the gumma has burst the appearances are usually easily recognizable.

Treatment consists of the administration of iodides, combined with a full treatment of the underlying disease by means of mercury and of either salvarsan or neosalvarsan. It is my plan, in hitherto untreated cases, to commence with from two to five intravenous injections of salvarsan or neo-salvarsan at intervals of from ten to fourteen days followed by mercury for about a year or longer. It is wise to vary the preparation and the method of administering the mercury from time to time, and also to allow progressively elongating intermissions as the course proceeds. Treatment should not be abandoned until Wassermann tests, performed at least three months after the last dose of mercury, are persistently and definitely negative. If it be desired to ascertain the Wassermann reaction before waiting at least three months from the cessation of treatment, a provocative injection of salvarsan may be given, and the blood examined within the following twenty-four hours.

Cysts of the Breast

The many varieties of cyst found in the breast may be classified as follows :

(1) *Retention Cysts arising in Ducts.*
    (*a*) Large ducts.
        Galactocele.
        Simple subareolar cyst.
    (*b*) Smaller ducts.
        Involution cysts in chronic mastitis.
        Sub-variety—general cystic disease of the breast.
    (*c*) Some cysts associated with the presence of a neoplasm (see below).
(2) *Serous Cysts arising in Lymphatic Spaces.*
(3) *Parasitic Cysts*, e.g. *Hydatids.*
(4) *Neoplastic Cysts.*
    (*a*) Arising in the tumour itself.
    (*b*) Duct-dilatations secondary to obstruction due to the presence of the neoplasm, *e.g.* cystic duct-papilloma.

Among the examples of neoplastic cysts may be mentioned :

(*a*) Cystic duct-papilloma.
(*b*) Cystic fibro-adenoma.
(*c*) Cysto-sarcoma.
(*d*) Cysts in carcinoma.

These will be discussed later under " Tumours of the Breast."

The decision that a given lump in the breast is a cyst and not a solid tumour is often difficult, for the cyst may be so tense that no sense of fluctuation can be elicited ; such a cyst on careful examination is often elastic rather than fluctuant, on the one hand, or firm, on the other. The diagnosis between a cyst and a solid tumour, and, when the cystic character is obvious, between a cyst of innocent character and one associated with malignant disease, is of such vital importance to the patient that in every case of doubt examination of the contained fluid after aspiration or, much better, an exploratory incision with microscopical examination is strongly to be advised.

1. **Retention Cysts.**—(*a*) *Galactocele.*—As a result of some obstruction in one of the main ducts in a lactating woman, milk may be pent up and become more or less altered and thickened. Such an obstruction may be due to an injury, to a sore or a scar near the nipple, or in some cases perhaps to a collection of proliferated epithelium within the lumen. Although it has been stated that cases occur in non-gravid women, the condition practically always arises during pregnancy and lactation; the cyst may, however, persist afterwards. It presents itself near the commencement of lactation as a rounded, painless, fluctuant tumour, from which on firm pressure a milky fluid can be expressed through the nipple. It is rarely more than 2 to 3 inches in diameter. On incision it is found that the contents are milky or buttery, and the walls composed of fibrous tissue lined with a flattened epithelium.

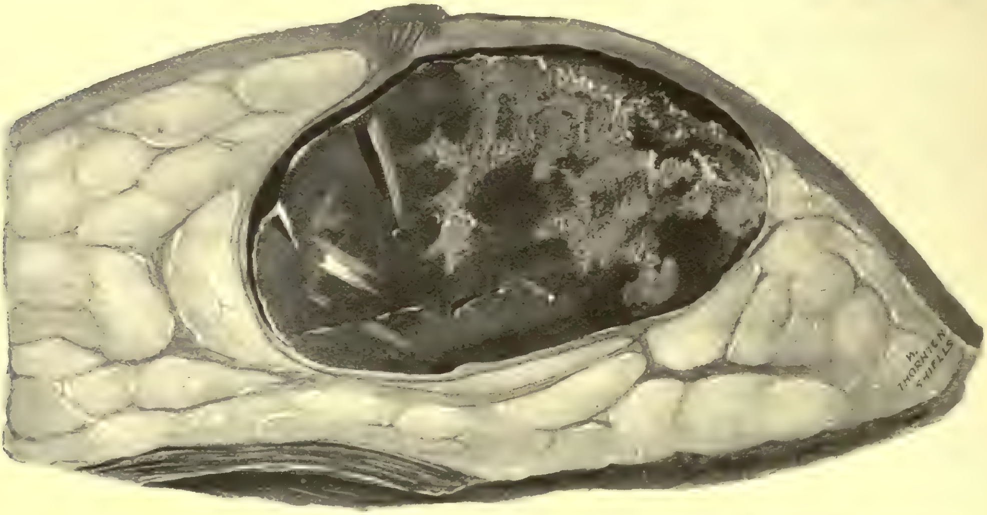

FIG. 9.—Subareolar mammary cyst filled with mixture of blood-clot and inspissated serum. (From a specimen in the Museum of The Seamen's (Dreadnought) Hospital.)

The *diagnosis* can usually be readily made from the cystic character of the swelling, its origin in connection with lactation, its nearness to the nipple, and the possibility of expressing a milk-like exudate.

Treatment.—The child must be weaned, the contents of the cyst removed by aspiration, and the breast strapped. If the swelling re-forms, an incision radiating from the nipple should be made, and the cyst be either wholly excised or opened and packed with gauze.

(*b*) *Simple Subareolar Cyst.*—A single cyst, about 1 inch in diameter and containing clear serous fluid, is sometimes found near the areola. Owing to their comparatively superficial position fluctuation is usually palpable. It is due to obstruction of one of the larger ducts, and is frequently associated with chronic mastitic induration of the corresponding lobe.

Although a serous discharge from the nipple is sometimes seen, its presence should suggest that the cyst may really be papillomatous in character, and should demand further exploration.

Treatment.—Although attempts may be made to obliterate the cyst by aspiration, followed by injection of pure carbolic acid and pressure, it is far safer to excise the swelling through a radiating incision, in order not only to cure the condition, but also, by subsequent microscopical examination, to ascertain with certainty its innocent character.

(*c*) *Cysts of the Smaller Ducts.*—The 'involution' cysts associated with chronic mastitis have already been discussed (see p. 20), and it has been shown that general cystic disease of the breast is merely an exaggeration of the same condition. These cysts are of special interest in that they may prove to be a precancerous change.

2. **Serous Cysts** may arise in lymphatic spaces. They require no special description.

3. **Parasitic Cysts.**—*Hydatid cysts* are very rare in the breast. They are due to the development therein of scolices of the tapeworm, *Taenia echinococcus*, and are therefore more prone to occur in women who have lived in Australia and Iceland, although the disease is far from being unknown in patients who have never left Great Britain.

The cyst grows insidiously, for a long time producing no special signs except those of an increasing swelling; but sooner or later, one of several complications may arise: (1) Suppuration may occur within the cyst, and the abscess so formed may burst externally; cure may follow, but frequently chronically discharging sinuses result. (2) The cyst may burst into the surrounding tissues, without suppurating, and cause considerable local inflammatory reaction, and perhaps a general urticarial rash. (3) The causative organisms may die, and the cyst slowly shrivel into a firm fibrous or calcareous mass.

Clinical Features.—The condition is usually first accidentally observed as a rounded, firm, elastic, painless lump in, and moving with, the breast, but not adherent to skin or pectoral fascia, and not associated with enlargement of the axillary lymphatic glands. Fluctuation is often demonstrated with difficulty until the tumour has attained at least the size of a Tangerine orange, but may then usually be elicited. I have never been able to satisfy myself that I have felt the so-called 'hydatid thrill ' here or elsewhere. The tumour progressively, but slowly, enlarges until death of the organism occurs, often followed by shrivelling and calcification or fibrous encapsulation of the cyst. If suppuration supervenes the skin becomes reddened ; the abscess points, perhaps at several spots, and bursting, discharges a fluid pus containing hooklets and perhaps daughter-cysts.

Diagnosis.—When the hydatid is small the diagnosis may be suspected from the discovery of a rounded, slowly-growing cyst, not associated with a discharge from the nipple, in a patient who has lived in a *Taenia*-infected country. It is attained with greater certainty, if on aspiration the contained fluid is found to be clear and non-albuminous, and with absolute surety if the fluid contain hooklets. In the later stages the size and slowly-persistent enlargement of the fluctuant swelling are important diagnostic features.

Prognosis and Treatment.—A complete cure may be expected if, before suppuration has commenced, the cyst be excised, complete and unburst, through a radiating incision, and the resulting cavity be obliterated by buried catgut stitches and by careful suture of the skin. If suppuration has occurred, the prognosis depends on the secondary infection and on the degree to which the breast has become permeated with sinuses. Then the treatment should consist of thorough splitting up of the sinuses, followed by packing to ensure healing from the bottom. If the whole breast be riddled, it should be removed. Hydatid disease localized in the breast does not endanger life.

TUMOURS OF THE BREAST

Mode of Examination.—In examining a lump in the breast systematic note must be taken of the following points :

(*a*) Rate of growth. This may be of prognostic as well as of diagnostic value ; thus the outlook for a patient with a carcinomatous tumour which has been known to exist without marked change for years is much better than that for one with a rapidly-growing tumour.

(*b*) Pain. In many conditions, *e.g.* in fibro-adenoma, pain is absent or if present is of a ' neurotic ' type. Pain originating in mammary disease is sometimes referred to the scapular region, instead of to the breast itself. The pain of an abscess is throbbing, that of an advanced carcinoma often lancinating, boring, or neuralgic, and sometimes referred to the shoulder.

(*c*) Age and general appearance of the patient.

(*d*) Relationship to periods of sexual development, such as puberty, menstruation, pregnancy, lactation, and the menopause.

(*e*) Discharge from the nipple. This may be *purulent* in acute mastitis; *serous* in duct-papilloma, duct-carcinoma, or chronic mastitis; or *sanguinolent* in duct-papilloma or duct-carcinoma. Inasmuch as persistent serous or sanious discharge is frequently found to be associated with an impalpable duct-papilloma, and as duct-papilloma shows a strong tendency to become carcinomatous, I agree with Handley's contention that *persistent* discharge from the nipple is a sufficient indication for removal of the breast, especially in a patient nearing the age of involution.

(*f*) Raising of the level of the nipple and its retraction are signs of importance in scirrhus.

(*g*) Flattening of the affected breast, as compared with its fellow, may be observed in scirrhus, and in late stages of chronic mastitis.

(*h*) The examination of the tumour by inspection and palpation should include measures designed to ascertain:

(1) Its size.

(2) Its relationship to the breast-tissue itself.

(3) The possibility of moving it apart from the nipple.

(4) Its consistence, whether fluctuant, elastic, rubbery, or leathery, or stony hard.

(5) The nature of its surface, whether smooth, craggy, nodular, or lobulated.

(6) Its shape—a sector-shape often implies chronic mastitis, an irregular disregard of the normal partitions of the breast often suggests carcinomatous spread.

(7) Its palpability with the flat hand as well as with the fingers and thumb—an induration due to chronic mastitis without tense cyst-formation, without inclusion of a fibro-adenoma or development of a carcinoma, although readily palpable when 'picked up,' appears to disappear when examined with the flat hand.

(8) Relationship to surroundings.

(*a*) The skin may show signs of involvement: it may be reddened, congested, and thinned by a pointing abscess; oedematous in tuberculosis or a deep-seated abscess; adherent to the breast in carcinoma, late tuberculosis, and syphilis; coarse and pitted like orange-rind in carcinoma and occasionally in tuberculosis and syphilis. Adhesion to the breast-tissue is best elicited by gently picking up the suspected area between finger and thumb; if it be adherent it becomes crinkled. In sarcoma and in large, soft fibro-adenoma the overlying veins are often obviously enlarged and dilated. In the later stages of abscess, tuberculosis, and actinomycosis the skin is penetrated by discharging sinuses perhaps at many points; in tertiary syphilis it may show an irregularly-rounded ulcer with a dirty, sloughy, yellowish-grey base; in late carcinoma it is reddened and perhaps eroded by an evil-smelling, painful, and spreading sore ; whilst in the terminal stages of sarcoma it is replaced by a fungating mass of growth.

(*b*) The nipple may be raised above the level of its fellow and may be retracted in carcinoma ; here a clear distinction must be drawn between the positive retraction due to disease and the developmental abnormalities described on p. 10.

(*c*) The adhesion of the breast to the subjacent fascia and muscles may be elicited by attempting to move the breast, both in and across the long axis of the muscular fibres, when the muscles have been fixed either by raising the arm above the head or by causing the patient strongly to contract the muscles by pressing the palms of the hands firmly together.

(*d*) Enlargement of the axillary, subclavicular, and supraclavicular glands. The axillary glands are best felt by passing the examining fingers far up into the armpit, and then gently dragging them downwards along the inner wall of the axilla. A proper examination of the subclavicular glands is important for, as already seen, they may, in certain cases, become affected before the axillary glands are palpable.

(9) Failure to observe disease in the other breast is inexcusable.

In all cases of doubt a portion of the diseased tissue should be removed for microscopical examination, or the contents of a fluid swelling aspirated for diagnostic purposes.

Classification.—Tumours of the breast may be conveniently arranged under the following headings :

A. *Innocent* (not tending to recur locally if thoroughly removed, or to infiltrate surrounding tissues, or to cause metastases to distant parts, or to permeate lymphatics, or to progress inevitably towards death).

(*a*) Chiefly composed of epithelium.
    (1) Duct-papilloma.
    (2) Adenoma (pure).
(*b*) Chiefly composed of connective tissue.
    (1) Fibro-adenoma
        Hard.
        Soft.
        Cystic.
        Fungating.
    (2) Fibroma (?).
    (3) Lipoma.
    (4) Myxoma.
    (5) Chondroma and osteoma (?).

B. *Malignant.*
- (*a*) Of epithelial origin—carcinoma.
  - (1) Spheroidal-celled and arising from the acini.
  - (2) Columnar-celled and arising from the ducts.
- (*b*) Of endothelial origin—endothelioma.
- (*c*) Of connective-tissue origin—sarcoma.

INNOCENT BREAST TUMOURS

Duct-Papilloma. (*Synonyms*: Papillary cystadenoma; Papilliferous cysts; Intracystic papilloma.)—In one or more of the galactophorous ducts, usually near the nipple, a small, soft, papillomatous mass arises, and often, by blocking the affected duct or ducts, causes the formation of a dilatation cyst, which may, however, be palpable with difficulty. The condition shows no predilection for the married or the unmarried, and may occur at any age after puberty, although it is most frequently seen in the decade preceding the menopause.

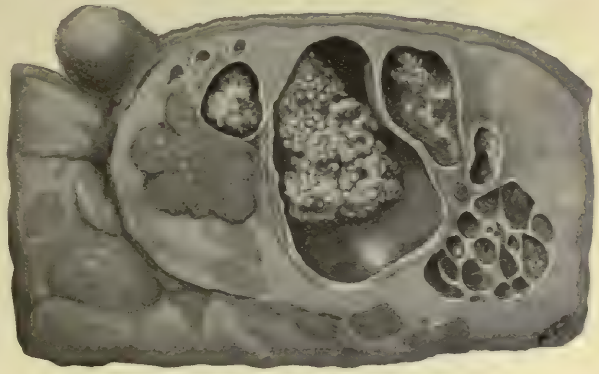

FIG. 10.—Duct-papillomata. Intracystic growths. (Museum of The Seamen's (Dreadnought) Hospital.)

Morbid Anatomy.—Soft papillomata, presenting microscopically a columnar epithelium set on fine, vascular, branching, fibrous processes, are found within one or two dilated ducts, especially near their orifices. The fluid contained in the cysts may be clear and yellowish, or may be stained with blood-pigments varying in tinge with the age of the cyst and the freshness of the outpoured blood; in some cases but little fluid is found, the cyst being almost filled with branching papillomata. The mammary lobes corresponding to the blocked ducts are frequently indurated by chronic mastitis.

Clinical Features.—A small, freely-movable, firm lump very slowly develops without causing adhesion to skin or fascia, or retraction of nipple; in the earlier stages this may be quite impalpable for a long period. Although it is not invariably present, the most constant symptom is a serous, or, more often, a blood-stained discharge from the nipple; this, especially if associated with chronic induration in a few lobes, should lead to a strong suspicion of the presence of duct-papillomata.

Pain is usually absent ; rarely a painful sensation is caused by rapid distension of the cyst due to sudden and complete blockage of the duct.

Prognosis.—(*a*) The condition may persist for years, slowly growing, but causing no specially unfavourable symptoms.

(*b*) The cystic element may predominate, and the tumour develop into a cyst 3 or 4 inches in diameter (*Cystic Duct-Papilloma*).

(*c*) The overlying skin may undergo pressure atrophy, and give way to permit the extrusion of the papillomata as a congested bluish-red and haemorrhagic mass (*Fungating Duct-Papilloma*).

(*d*) Suppuration may occur, an abscess burst, and perhaps the papillomata may fungate through the orifice so formed.

(*e*) Too often, if a duct-papilloma be neglected, *carcinomatous* changes supervene.

Treatment.—Although sometimes the local mass may be excised, it is wiser, owing to the fear of cancerous developments, to remove the whole of the breast itself.

Pure adenoma.—This very rare condition clinically resembles a soft fibro-adenoma (*q.v.*), but is almost entirely composed of hyperplastic epithelial acini of normal appearance, held together by a minimal amount of interacinous connective tissue and of fat.

Treatment.—If it be sufficiently small it may be excised, but if of any size it will involve removal of the breast.

Fibro-adenoma.—1. *Hard Fibro-adenoma.*—The ordinary or hard fibro-adenoma is one of the commonest mammary tumours. It consists of a firm mass of fibrous tissue, arranged in laminae and whorls, in which here and there are to be seen narrow clefts representing the remains of epithelium-lined lumina. It is possessed of a perfect capsule (Fig. 11) and is therefore readily enucleable.

Etiology.—The tumour practically always develops between the ages of puberty and thirty years, although it may not be discovered until later ; marriage and childbirth seem to have no special influence over its origin, although occasionally a fibro-adenoma is observed to increase its rate of growth during pregnancy. The history of a blow, regarded by the patient as of prime etiological significance, is very common.

Morbid Anatomy.—The tumour is well encapsuled, often lobulated, possesses but loose connection with the breast, and is very freely movable. Although sometimes deeply embedded in the mammary tissue, most commonly it is placed near the surface, especially near the nipple, or near an edge, or in the axillary tail of the breast. One or more tumours may be present, and in the latter case both breasts may be affected.

On section the tumour presents an opaque fibrous appearance, and a white or pinkish-white colour. The dense fibrous tissue is often arranged in whorls, at the centre of which, on close examination, a cleft may be descried; this cleft represents the almost obliterated lumen of the duct or acinus, and is lined by a crushed and inactive cubical epithelium which has been imprisoned by the overgrowth of the periductal or peri-acinous fibrous tissue, and its ingrowth in the form of closely-packed, rounded, or squared processes into the lumen. This description applies to the common 'intracanalicular' variety (Fig. 12) of hard fibro-adenoma ('coarse papilloma'); occasionally the form known as the 'pericanalicular' is seen in which ingrowth of the hypertrophied stroma is not in evidence, so that the centre of the whorl is occupied by an unobliterated and scarcely altered duct or acinus.

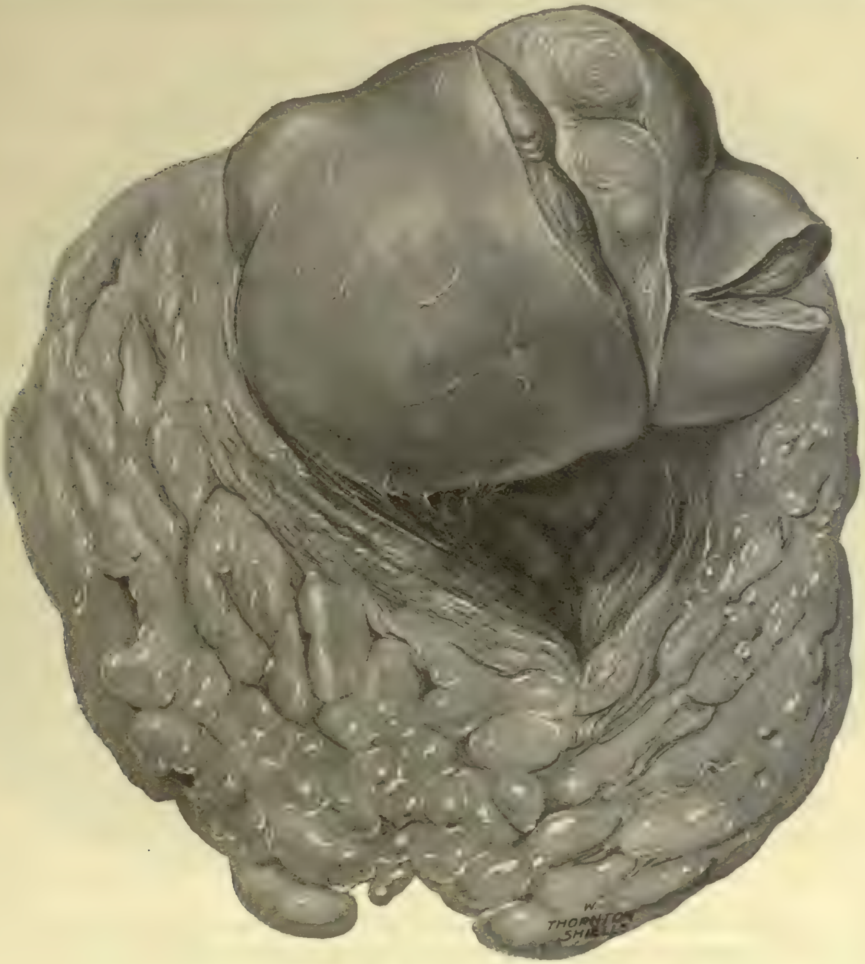

Fig. 11.—Fibro-adenoma of the breast, showing the well-marked capsule.

The surrounding breast-tissue may remain normal, or may present an area of coarsely-granular mastitic induration corresponding to the ducts blocked by the presence of the fibro-adenoma. Occasionally, if the fibro-adenoma be large and deeply placed, mammary tissue is stretched over it, and the breast appears on inspection to be an example of unilateral hypertrophy; this is, however, more common with the soft than with the hard variety of fibro-adenoma. The ordinary hard fibro-adenoma rarely exceeds a maximum diameter of 3 inches.

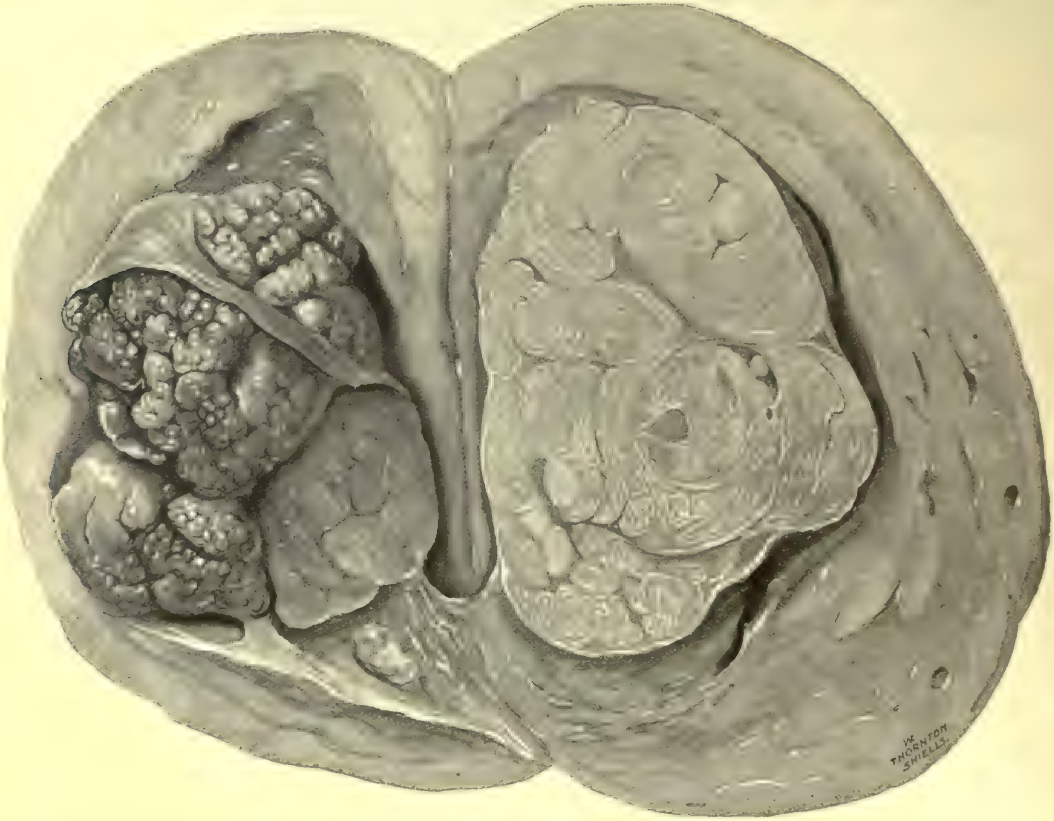

Fig. 12.—Fibro-adenoma mammae.

The right side shows the whorl-like arrangement in section. The left shows the manner of ingrowth of blunt processes by which the tumour is formed (intracanalicular fibro-adenoma). (Museum of The Seamen's (Dreadnought) Hospital, Greenwich.)

Clinical Features.—A rounded, often lobulated, firmly elastic, smooth lump of moderate size is found, usually by chance, in the breast. It is very mobile, slipping about under the examining fingers, not adherent to skin or fascia, and movable apart from the nipple. Large examples press forward and, thinning the overlying skin, are easily seen, as lobulated tumours often associated with dilatation of cutaneous veins. The axillary glands are not affected. The fibro-adenoma may be accompanied by chronic mastitis which may impair its mobility, but unlike the latter it is palpable with the flat hand. Pain may be of a neuralgic character, especially at the menstrual periods, but is usually absent except in neurotic patients.

Diagnosis is usually readily made by the physical signs, especially if the patient be under thirty. Occasionally it is difficult to distinguish a fibro-adenoma with mastitis from a slowly-developing fibrotic carcinoma, which is still freely movable : in any case of doubt, especially in a woman over thirty, an exploratory operation should be performed.

Treatment.—A policy of watchful expectancy may be adopted if the lump is not growing and the patient is under thirty ; but if the tumour cause any symptoms, mental or local, or if the patient be over thirty when the condition is first observed, excision is advisable. This may be done through an incision over the tumour and radiating from the nipple. If the lump be large or deeply placed, or if the patient for aesthetic reasons desires concealment of the scar, Gaillard Thomas's method may be adopted ; in this a semilunar incision is made in the submammary sulcus, the breast raised from the thoracic wall and the tumour removed through the route thus opened up. This method must never be adopted if any suspicion of malignancy exists.

2. *Soft Fibro-adenoma* (and *Cystic Fibro-adenoma*).—A soft fibro-adenoma differs from the ordinary variety in that it possesses a markedly cellular instead of a densely fibrous stroma, that it grows rapidly to a size unattained by the hard fibro-adenoma, that it is much softer in consistence, and that it is chiefly found in women above thirty-five. These rare tumours, although benign in type, may reach a diameter of 6 or 7 inches in a few months, and cause marked protrusion of the breast of one side. The tumour remains movable and free from adhesions to skin or muscular fascia ; the overlying cutaneous veins may be enlarged and obvious, but the axillary glands are not enlarged.

Owing to the embryonic character of the stroma much confusion has existed between soft fibro-adenoma and sarcoma ; so that many of the older writers described this tumour as a cysto-sarcoma or an adeno-sarcoma. Mucoid degeneration may occur in the stroma ; small cysts, sometimes acinous, sometimes mucoid, are frequently found. In some cases cyst-formation, either due to dilatation of the epithelium-lined spaces, or to mucoid degeneration of the stroma, proceeds to a marked degree, and the soft fibro-adenoma becomes a *cystic fibro-adenoma* (or according to other nomenclatures adenocele, cystadenoma, cysto-sarcoma, cystic adeno-sarcoma, or sero-cystic sarcoma).

The clinical features of the cystic fibro-adenoma are those of the soft fibro-adenoma with the addition of fluctuant or elastic areas of some size.

Very rarely in neglected cases such a cystic fibro-adenoma may fungate through the overlying skin and protrude as a mass of blunt foliaceous processes, which soon become inflamed, congested, and haemorrhagic; the condition is then known as a *fungating cystic fibro-adenoma* (or fungating cystadenoma). Its resemblance to a fungating sarcoma is very close.

Diagnosis.—A unilateral *large* increase in size of the breast is almost always due either to soft fibro-adenoma or to sarcoma. If there be adhesion to skin or fascia, enlargement of axillary glands, evidence of infiltration of surrounding tissues, and absence of the epithelium-lined chinks in a microscopic section, sarcoma may be diagnosed. Fungation through the skin may occur in either disease, but is perhaps commoner in sarcoma.

Treatment.—The whole breast should be removed with the tumour; if on careful microscopic examination any evidences of sarcomatous infiltration are found, the muscles, fasciae, and lymphatic glands should then be swept away without delay.

Pure fibromata must be very rare; probably most recorded instances are examples of fibro-adenomata in which the imprisoned epithelium has been squeezed until it is unrecognizable.

Lipomata, myxomata, chondromata, and *osteomata* are all very rare, and require no special description.

MALIGNANT TUMOURS OF THE BREAST

Here, as elsewhere, a malignant tumour displays tendencies to grow atypically away from the character of the organ in which it arises, to infiltrate and destroy the surrounding tissues, to travel to distant parts by lymphatics, blood-vessels or both, to 'breed true' to itself in the secondary growths so caused, and to progress ruthlessly towards the death of the patient.

Carcinoma of the Breast

Preliminary Remarks.—The fundamental characters of a carcinoma, best seen at its margins, are the atypical growth of epithelial cells, and their irruption into neighbouring tissues. In the older more central parts of the tumour the essential features may be obscured by the reaction of the stroma to the growth.

To some extent the physical characters and the rate of growth of the epithelial tumour are governed by the degree to which this reaction occurs; thus in the soft, rapidly-advancing 'encephaloid' carcinomata the stroma often consists of slight, loosely-woven, vascular strands interposed between the epithelial masses, whilst in the slow-growing, hard ' atrophic ' scirrhus it is densely fibrosed, and forms the most obvious part of the neoplasm, the cellular elements being scattered amongst firm fibrous tissue. But even in these cases the essential basis of the tumour is formed by the masses of epithelial cells, not intersected by intercellular connective tissue.

Etiology.—The results of the unceasing efforts to discover the fundamental causes of tumour-invasion are yet so indeterminate that their discussion is out of place here ; but certain factors have a predisposing influence on the development of cancer of the breast.

(*a*) *Sex.*—In women the breast is, after the uterus, the commonest situation of cancer ; in males on the other hand, it is rarely affected.

(*b*) *Age.*—Although no age from about twenty years till extreme senility is exempt, the disease is rare before mid-life, and is commonest during the years of sexual involution and degeneration just after the menopause.

(*c*) *Trauma.*—A history of previous injury is frequent, and sometimes suggestive, but no definite causative relationship can be affirmed.

(*d*) *Site.*—The upper and outer quadrant is affected in nearly half the cases, but any part of the breast, even outlying ' tails ' or accessory mammae, may suffer.

(*e*) *Heredity and Domicile.*—Although some examples of several cases arising in the same family or in the same house have been recorded, their infrequency, relative to the exceedingly wide incidence of the disease, prevents the serious consideration of heredity or of domicile as etiological agents. Bashford has recently pointed out that mice living in cages previously inhabited for years by generations of other mice suffering from mouse-tumour do not thereby become affected.

(*f*) *Marriage* appears to exercise no special influence.

(*g*) *Precancerous Conditions.*—1. *Chronic Mastitis.*—Clinical and pathological evidence of the presence of chronic mastitis in the same and in other parts of the cancerous breast are so commonly found that this condition must rest under the very strong suspicion of being one of the commonest precursors of carcinoma. This seems to be especially true of the advanced cases of chronic mastitis known as ' cystic disease of the breast.'

2. *Duct-papilloma,* as already stated, frequently ends as a duct carcinoma.

3. Handley[1] produces some evidence in favour of the supposition that a precedent *fibro-adenoma* is an occasional starting-point of a carcinoma, either by causing irritation of the area of chronic mastitis that so often surrounds it, or possibly by

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[1] In Choyce's *System of Surgery,* vol. ii. p. 51.

undergoing direct mutation of tumour-type. This latter must, however, be very rare.

Morbid Anatomy.—The carcinomata of the breast itself may, from the microscopic point of view, be divided into two types according to whether they have arisen from the acini or from the ducts. The duct-carcinoma, much rarer than the acinous variety, is essentially composed of columnar cells. The carcinoma of acinous origin is primarily a *carcinoma simplex*, composed of spheroidal cells massed in solid branching columns and processes, which are separated by a moderate amount of connective-tissue stroma. The ordinary *carcinoma mammae* belongs to this undifferentiated spheroidal-celled type in which the definite acinous arrangement is not seen ; but various accidents of development modify the microscopic and macroscopic appearances and have justified division into subclasses. Thus occasionally the original alveolar arrangement of the epithelium is retained to some extent, and the tumour may be called an *alveolar* carcinoma, *adeno*-carcinoma, or *acinous* carcinoma. Again, if the stroma between the cellular processes is scanty and delicate, and the cohesion between the cells loose, the neoplasm is large, rapidly advancing,

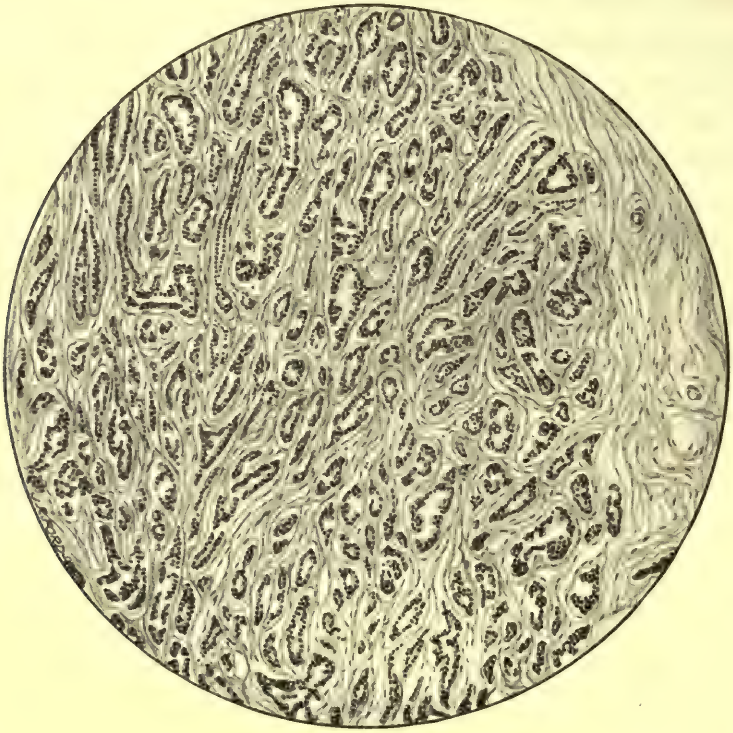

Fig. 13.—Alveolar carcinoma mammae.
(From Cuthbert Lockyer's specimen.)

soft, cellular, and juicy, and is known as an *encephaloid* or *medullary* carcinoma. In the *scirrhus*, the most usual type, the cell-masses are numerous, but have lost their alveolar arrangement, and the stroma between them is well developed. In the *atrophic scirrhus* the epithelial proliferation is defective as compared with the reaction of the stroma, which is composed of sclerosed fibrous tissue. If colloid degeneration is strongly in evidence the term *colloid* carcinoma is sometimes applied.

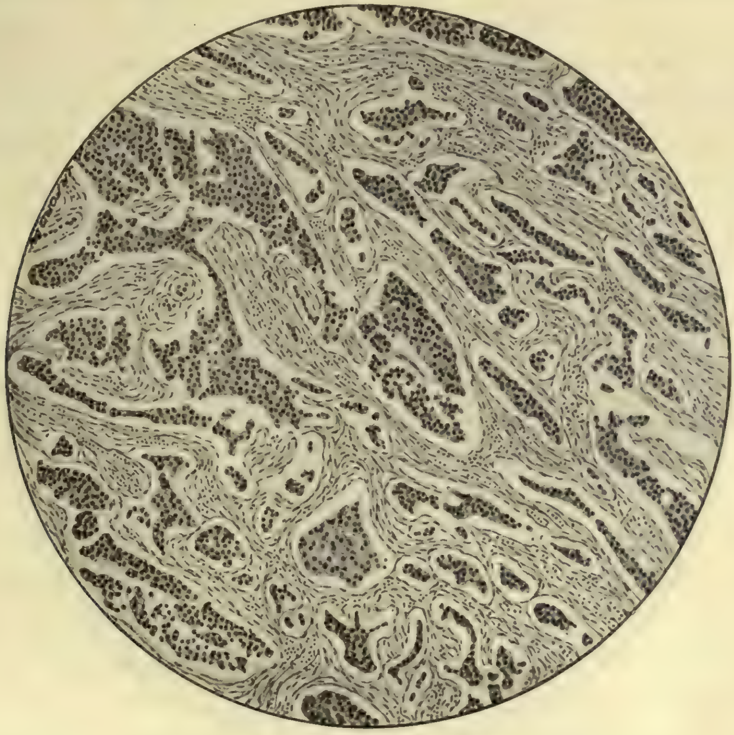

FIG. 14.—Very cellular carcinoma mammae.

Therefore, to sum up, the carcinomata of the breast may be classed under the following heads :

1. Spheroidal-celled—of acinous origin.
    (1) The ordinary scirrhus—a *carcinoma simplex* with well-developed stroma.
    (2) Atrophic scirrhus.
    (3) Alveolar, acinous, or adeno-carcinoma.
    (4) Soft, medullary, or encephaloid carcinoma.
    (5) Colloid carcinoma.
2. Columnar-celled—of duct-origin—duct-carcinoma.

Carcinomata arising in the nipple or in the skin over the breast are not included here.

1. *Spheroidal-celled Carcinoma of Acinous Origin.*—It will be seen therefore that, allowing for the necessary modifications to correspond to the various subdivisions, the *microscopic appearances* of the carcinoma of acinous origin may be based on those of the ordinary scirrhus variety of *carcinoma simplex.* They are as follows: Solid columns or masses of cells without intercellular vessels or connective tissue are arranged between intercolumnar vascular strands of well-formed stroma. The cells often retain their spheroidal shape, but in parts of the neoplasm they may be regularly or irregularly flattened. They contain a large, freely-staining nucleus set in a granular protoplasm.

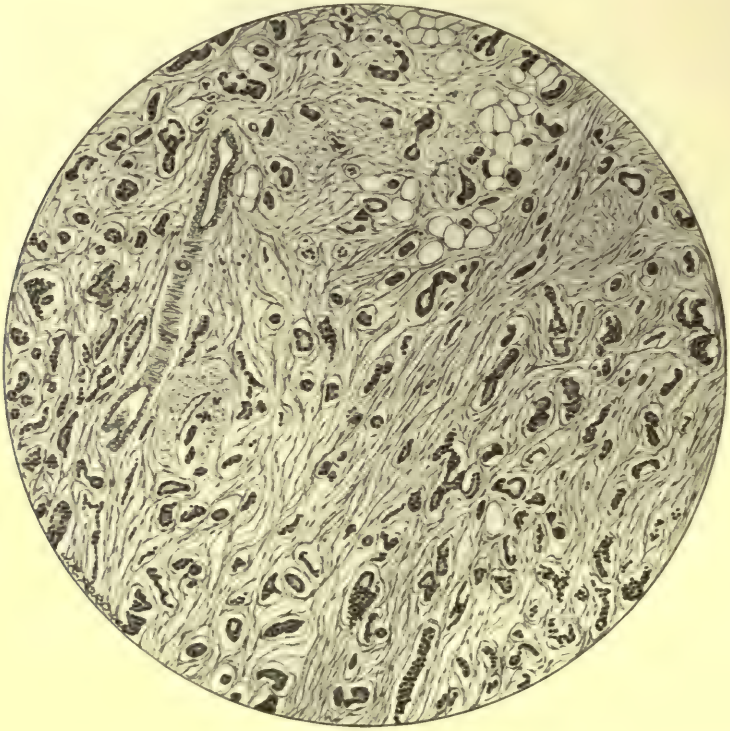

FIG. 15.—Scirrhus mammae.

Macroscopic Appearances.—On section an *ordinary scirrhus* cuts with a creaking sensation, and a definite feeling of hardness. The cut surface is greyish-white, sometimes mottled with yellow patches; it is slightly concave, and on pressure or scraping exudes 'cancer-juice,' a scanty, milky, cellular fluid. From the edge of the neoplasm fine prolongations can often be traced into the surrounding tissues. The skin and submammary fascia may be adherent to the breast in the region of the tumour, and the nipple may be retracted.

The *atrophic scirrhus* differs from the ordinary scirrhus only in its slower growth and its excessive fibrosis. The contraction of the sclerosing tissue may cause actual shrinkage of the whole breast, and the neoplasm itself may be converted into a concave, discoid, nodular mass of almost stony hardness. Such a tumour may occasionally lie concealed and unrecognized in the breast of an elderly woman for years until death from old age occurs, or until ‘ spontaneous fracture ’ of the femur attracts attention to a secondary deposit in that bone and initiates a search for the primary growth.

A medullary or encephaloid carcinoma is largely composed of loosely-arranged cell-masses, the stroma being slight and delicate. It feels soft, cuts without creaking, and grows rapidly.

Mention should be made here of *acute diffuse carcinoma* (*mastitis carcinomatosa, carcinoma mastitoides*), a terrible clinical variety of the soft type. It occurs in comparatively young women, especially in association with lactation, and infiltrates the whole breast with such extreme rapidity that probably it originates at many separate points simultaneously (*multicentric* origin).

2. The *columnar-celled duct-carcinoma* presents a different picture both on macroscopic and microscopic examination, although one variety, that arising in the smaller ducts, approximates in many characters to the spheroidal-celled tumour of acinous origin.

(*a*) The more typical form originates in the larger ducts usually near the nipple, probably as the result of malignant degeneration of benign duct-papillomata. Spaces formed by the dilated ducts are found stuffed with papillomata, or sometimes with a mixture in varying proportions of degenerated cancerous cells, glandular secretion, and haemorrhagic remains. From the margins of the mass cellular ingrowths pass into the surrounding tissues, but the rate of advance is comparatively slow, involvement of axillary glands, and adhesion to neighbouring skin and fasciae are of late occurrence, and retraction of the nipple is uncommon. This form usually attacks elderly women and has a better prognosis than the ordinary scirrhus.

(*b*) The variety of duct-carcinoma arising in the smaller ducts, as might be expected, is not always to be distinguished from the spheroidal-celled neoplasm originating in the alveoli ; in some cases, probably those in which small ducts and acini are both affected, the columnar-celled and the spheroidal-celled types appear to be mixed. Through the mammary tissue erratically growing processes spread, containing small irregular spaces lined by columnar, cubical, or occasionally spheroidal-celled epithelium ; in some cases there are small but definite cystic spaces into which papillomatous infoldings project. Cheatle considers that, taking this type into account, the proportion of carcinomata arising in ducts to those commencing in acini is much greater than is usually thought; he states that if the whole of an apparently spheroidal-celled carcinoma be carefully examined, areas will be found with columnar cells suggestive of a duct-origin. He also points out that in some cases at any rate the small cysts found in this variety of cancer are not caused by obstruction of the ducts but by the activity of the epithelial growth; in one of his specimens a natural injection experiment had been made by haemorrhage and showed continuity of lumen between the cysts and the ducts.[1]

The Advance of Mammary Carcinoma.—At first spreading locally in the breast-tissue, the disease soon extends along fibrous trabeculae to adjacent *fasciae*, and then to the *skin*. Involvement of the lymphatic *glands* of the affected lymph-basins [2] is almost constant, especially in the carcinoma of acinous origin; it occurs later in the duct-carcinoma. Metastases in *bone* are especially common, and may by causing a constant dull aching pain or a 'spontaneous' fracture give the first warning of the presence of mammary cancer; in all cases of 'spontaneous' fracture search should be made, amongst other causes, for evidences of hypernephroma, or of cancer in the breast, prostate, or thyroid gland. Von Recklinghausen suggests that this special liability of bones to metastasis from the breast is due to the ease with which emboli would lodge in the inelastic capillaries within the bone. Handley points out that most spontaneous fractures secondary to mammary cancer occur in the parts of bones nearest to the trunk; thus they are rare below the middle of the thigh or below the insertion of the deltoid; he holds that this is contrary to what might be expected if the infection occurred through blood-borne emboli, and explains the fact by his theory of centrifugal permeating growth along the lymphatics of the fascial layers (see later). He supports his view by the observation that the area in which, as a rule, bone metastases may be expected, corresponds to that in which carcinomatous nodules in the skin are found in advanced cases.

Secondary growths are also sometimes to be found in the *lungs*, *liver*, in other abdominal organs, especially in the *pelvis*, and elsewhere; rarely in late cases the *other breast* becomes affected.

The paths by which carcinoma-cells spread in, and from the breast, fall under the following headings:

(*a*) Lymph-spaces—by infiltration.
(*b*) Lymph-vessels—by (1) permeation.
(*c*) ,, ,, ,, (2) embolism.

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[1] *Proc. Roy. Soc. Med.* (*Surg. Sect.*) pp. 241-244, 1914.

[2] The term 'lymph-basin' is here applied to the area drained into a definite group of glands (see p. 6).

(*d*) Blood-vessels—by embolism.

(*e*) Serous cavities—by transcoelomic implantation.

(*a*) Local *infiltration* accounts for the spread of the neoplasm in its immediate vicinity ; the cancer-cells burst their bonds, and grow along the lymphatic spaces between the constituent cells and fibres of the adjacent tissues.

(*b*) *Lymph-vessels.—Permeation* occurs by progressive growth of the cancerous processes along the lumina of the smaller lymphatic vessels. Handley holds, I think rightly, that this process of continuous centrifugal growth, first observed by Heidenhain in the pectoral fascia, is the chief factor in the spread of cancer to distant parts, and that although dissemination by embolism along lymphatics or along blood-vessels and transcoelomic implantation do sometimes occur, they are by no means such constant agents as growth by permeation. He shows that this permeation occurs in the lymph-vessels of the fasciae, especially therefore in the sheath of deep fascia that coats the trunk and carries the lymphatics, forming the great drainage areas or 'lymph-basins' of which mention has already been made. Many of these lymph-vessels are of a calibre too small to permit the free embolic passage of cancer-cells, but readily allow their multiplication and growth along their lumina.

The fact that distant secondary growths in the parietes are often apparently free from any obvious direct communication with the original growth he explains by the choking action of a perilymphatic fibrosis in obliterating the conveying lymphatic vessel after the cancer has grown along it. The most advanced part of the cancerous process (the microscopic growing edge) is inside the lumen of the lymphatic, which is not yet distended ; behind this is a portion which by its intraluminar proliferation has distended the lymph-vessel to the point of bursting, and has thereby set up a strong connective-tissue reaction, which first shows itself as a perilymphatic, small round-celled infiltration, and later as a perilymphatic fibrosis ; this tissue-reaction locally overcomes the cancerous cells and chokes the affected lymphatic vessel, so that there appears to be a gap free of cancer between the original growth and the present growing edge. This process is schematically illustrated in Fig. 16. From this cancer-infected deep fascial lymphatic sheath processes grow down along the tributary lymphatics through the muscles and up along the trabeculae to reach the skin. It will be seen that the direction of spread by permeation is independent of the direction of lymph flow until cells become detached in the larger lymphatics to form emboli travelling to the nearest glandular filters.

In favour of Handley's theory that the principal agent in carcinomatous extension is centrifugal growth by permeation of lymphatics, especially along the deep fascial plane, may be adduced his microscopic evidences, the favourable results of operations planned on his thesis, and the readiness with which it can be made to explain most of the clinical phenomena of the disease. Thus it accounts for the observed centrifugal distribution of secondary nodules in the skin ; if the skin only became infected by spread from lymphatic emboli, the nodules should all be situated along the line of the main lymphatics ; if from blood-emboli they should be scattered over the surface, especially at points of 'terminal' circulations, *e.g.* on the extremities. Moreover, the incidence of metastases in bones should especially affect the distal ends of limbs, whereas in fact they are commonest near their junction with the trunk. Secondary growths in internal viscera do not occur to the same extent in those organs most affected by pyaemia, an admittedly blood-borne disease ; thus the spleen is scarcely ever the seat of carcinomatous metastasis although splenic infection is not uncommon in fatal pyaemia ; this fact is against the theory that most metastases are due to emboli travelling in the blood-vessels. Handley explains the distant metastases in viscera by a process of transcoelomic implantation following permeation of the body-wall. The occasional late secondary involvement of the other breast is accounted for by a process of permeation across the middle line into the other pectoral fascia and axilla and thence by retrograde growth into the second mamma.

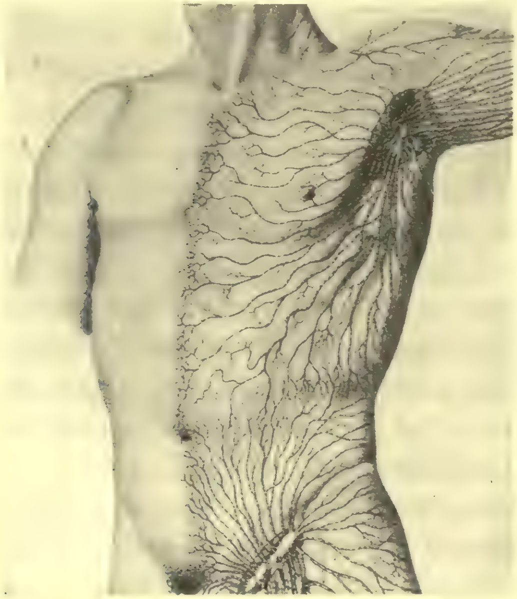


FIG. 16.—The lymphatic trunks of the deep fascial plexus. (After Sappey.)

Moreover, many of the clinical manifestations of mammary carcinoma are readily explicable by the tissue-contraction, and by the lymphatic obstruction caused by the perilymphatic fibrosis ; thus fibrotic contraction may be held responsible for the shrinking of the breast and the retraction and raising of the nipple ; 'orange-rind' skin, serous effusions, 'brawny-arm,' and the earlier stages of *cancer-en-cuirasse*, before definite cancerous infiltration has occurred, may all be attributed to the lymphatic obstruction.

In so far as the breast is concerned at any rate, Handley's thesis that centrifugal permeation is the "master process of dissemination" appears to me to be a good working one. However, it does not satisfactorily explain to me the not infrequent presence of metastases within the substance of the liver without involvement of its surface near the falciform ligament, where transcoelomic implantation from the permeated body-wall would naturally occur ; for this a process of blood-embolism must be assumed. Moreover, it is strange that the process of permeation from breast to the upper end of the femur, for example, is not more often to be detected in the deep fascia of the abdomen and flank ; that the metastases in bone are endosteal rather than periosteal, and that growths in bones secondary to cancer in internal organs also affect their proximal ends.

(*c*) *Embolism along Lymphatic Vessels.*—When by permeation the growth has reached lymphatic vessels large enough to permit the passage of cancerous cells along their lumina, emboli are doubtless often carried to the corresponding glands. The main lymphatic drainage from the mammary region is to the axillary glands and thence to the subclavicular and supraclavicular groups ; it must be remembered, however, that from the deep surface vessels pass direct to the subclavicular group, which may therefore be affected before the axillary glands. A few small and unimportant communicating lymphatics pass through the chest-wall with the perforating branches of the internal mammary artery, but they are small and the flow of their lymph sluggish, so that embolism does not occur along them ; cancer-cells may permeate along them to the intrathoracic glands, but, as a matter of fact, extension in this direction is uncommon.

(*d*) *Embolism along Blood-vessels.* — Transference of cancer-cells in the bloodstream no doubt occurs, though not with the frequency that was supposed when this route was made to explain all metastases in distant organs. As already stated, the distribution of the metastases differs in important details from that of pyaemic abscesses, in the localization of which the blood-stream and the arrangement of capillaries is admitted to be paramount ; if, therefore, the embolic theory be accepted as explaining distant carcinomatous metastases, a power of selective localization must be assumed for the emboli. It is difficult to attribute the occasional metastasis found in the brain to anything but blood-borne emboli.

(*e*) *Transcoelomic Implantation.*—The presence of metastases in the liver, pelvic organs, and lungs may be explained by an embolic hypothesis, but is more probably often accounted for by the falling of cells detached from a subserous nodule across the body-cavity (transcoelomic implantation) after the growth has reached the inner aspect of the body-wall by permeation from without. The relative frequency of *hepatic* deposits is accounted for by the immediate neighbourhood of that viscus to the epigastric notch, by the thinness of the abdominal wall in the middle line there, so that the deep fascia and the subserous layers are close together, and by the fact demonstrated by Stiles that the breast extends to within an inch of the epigastric notch. Isolated *central* hepatic metastases can be better explained by assuming infection by blood-borne emboli.

Similarly, when once the disease has permeated the body-wall and formed a subserous nodule, detached cells may readily become detached and secure a new site on *lungs*, *pelvic* organs, and other *viscera.*

Clinical Features of Breast-Cancer.—A. *Clinical Features of an Ordinary Scirrhus.*—(*a*) *Comparatively Early.*—In its early stages a scirrhus lies hidden in the breast, unfortunately causing no symptoms to attract the patient's attention; the growth is therefore commonly overlooked until secondary changes such as those due to fibrotic contraction or to involvement of skin become manifest; in some cases 'spontaneous' fracture of femur or humerus, ulceration of the breast or the discovery of metastatic deposits in lungs, pleura, or abdominal viscera, or of a mass of enlarged axillary glands may be the first sign observed.

In most instances the woman detects by chance, often whilst washing, the presence of a *tumour* in her breast. Occasionally her attention is drawn to it by *pain*, which, however, is a comparatively rare feature until a late stage of the disease; when present it may be extreme and persistent, but is more often of an intermittent, sharp, shooting, neuralgic character. Not infrequently it is referred by the patient to the shoulder or to the scapular region; sometimes it is only felt when the breast is moved by the examining hand, by its own weight during body movements, or by the contractions of the subjacent muscles.

When the patient presents herself to the surgeon she will usually be seen to be a woman past middle life, but not noticeably wasted below her normal habit, which is often stout and well nourished. Cachexia and wasting are late signs generally associated with septic absorption from a foul ulcer, combined with pain and sleeplessness.

On *inspection* in the earliest and most hopeful cases nothing is obvious, neither mammary tumour, axillary glands, nor evidence of skin involvement. On *palpation* a definite tumour is felt, and enlargement of glands may be detected. In all cases both breasts, both axillae, and both subclavicular and supraclavicular triangles should be examined.

The tumour is most commonly situated in the supero-external quadrant of the breast, but may lie anywhere in the mammary tissue, in an axillary tail, or even in an accessory breast. It can be felt as well with the flat hand as between finger-tips and thumb. Typically it is single, of small or moderate size, of stony-hard consistence, and of irregular but circumscribed shape, its edges and surface being often unsymmetrically nodular. It is not movable apart from the breast-tissue if the nipple be held. It is important to remember that to this statement there are apparent exceptions ; occasionally a carcinoma is found which presents physical signs almost if not quite indistinguishable from those of a fibro-adenoma ; even when removed it appears to be encapsulated. Therefore every breast-tumour of which there is the slightest suspicion in a woman over forty, should be removed for microscopic examination.

At first the skin can be freely moved over the lump, but comparatively soon the growth secures adhesion to it through the infiltrated 'suspensory ligaments' ; then the skin dimples and puckers when gently picked up between finger and thumb ; later it obviously becomes firmly tacked down (Plate II.).

The growth at an early stage involves the subjacent muscles and fasciae, and can then not be moved apart from them. This sign is best demonstrated by attempting to move the tumour in a direction *parallel* to the muscle-fibres after putting the muscles on the stretch either by raising the arm high above the head, or by causing the patient to press the palms together firmly in a suppliant attitude, and so to contract the pectoralis major.

In the surrounding breast-tissue it is not uncommon to feel an induration due to chronic mastitis ; if this contain tense cysts it may cause difficulty in diagnosis.

The *lymphatic glands.* Most commonly the axillary glands are first affected, followed by the subclavicular group, and later by those in the supraclavicular triangle. It must be remembered that in some instances the subclavicular glands may be attacked at an early stage even before those in the axilla ; therefore no operation is adequate that fails to remove them completely in all cases.

To demonstrate enlargement of the axillary glands, the surgeon causes the patient to relax all of her muscles and slightly abducts her arm ; he then passes his finger-tips as far up into the axillary apex as he can press them and slowly strokes them down the walls of the armpit, taking the inner wall first.

In an early case the glands may be impalpable, but generally they are enlarged, inelastic, hard, and mobile, but not tender. In the latest stages they form a mass fixed to skin and to thoracic wall ; operation is then useless. In late cases the glands of the opposite axilla may be affected.

To facilitate palpation of the subclavicular glands the patient should recline on a firm couch, with muscles completely relaxed, and with the arm resting easily forward and half-abducted on a pillow. This position is also the best to adopt when the surgeon is endeavouring to palpate a small and doubtful breast-tumour.

If the supraclavicular glands are enlarged, the prospects of a successful outcome are more remote ; but unless they are firmly fixed operation should be performed, the clavicle being temporarily divided if necessary to ensure complete removal of the growth in continuity.

Although it has been convenient to discuss here the later glandular involvements with the earlier, as a rule many of the signs now to be described chronologically precede enlargement of the supraclavicular glands and inoperable adhesion of the axillary group.

(*b*) *Later Signs* (visible signs).—At a comparatively early stage fibrotic changes occur, and some of the most characteristic and diagnostic signs become obvious. Thus the breast may become flattened as seen from a lateral view, the skin becomes dimpled, puckered, and obviously adherent to the neoplasm, and the nipple often becomes retracted, and not infrequently elevated above its fellow. In this stage of visible signs the *skin* may undergo several changes more or less in the following chronological order :

(i.) *Dimpling* and *puckering* on being picked up, indicative of infiltration of the 'suspensory ligaments.'

(ii.) Firm *adhesion* to the underlying neoplasm.

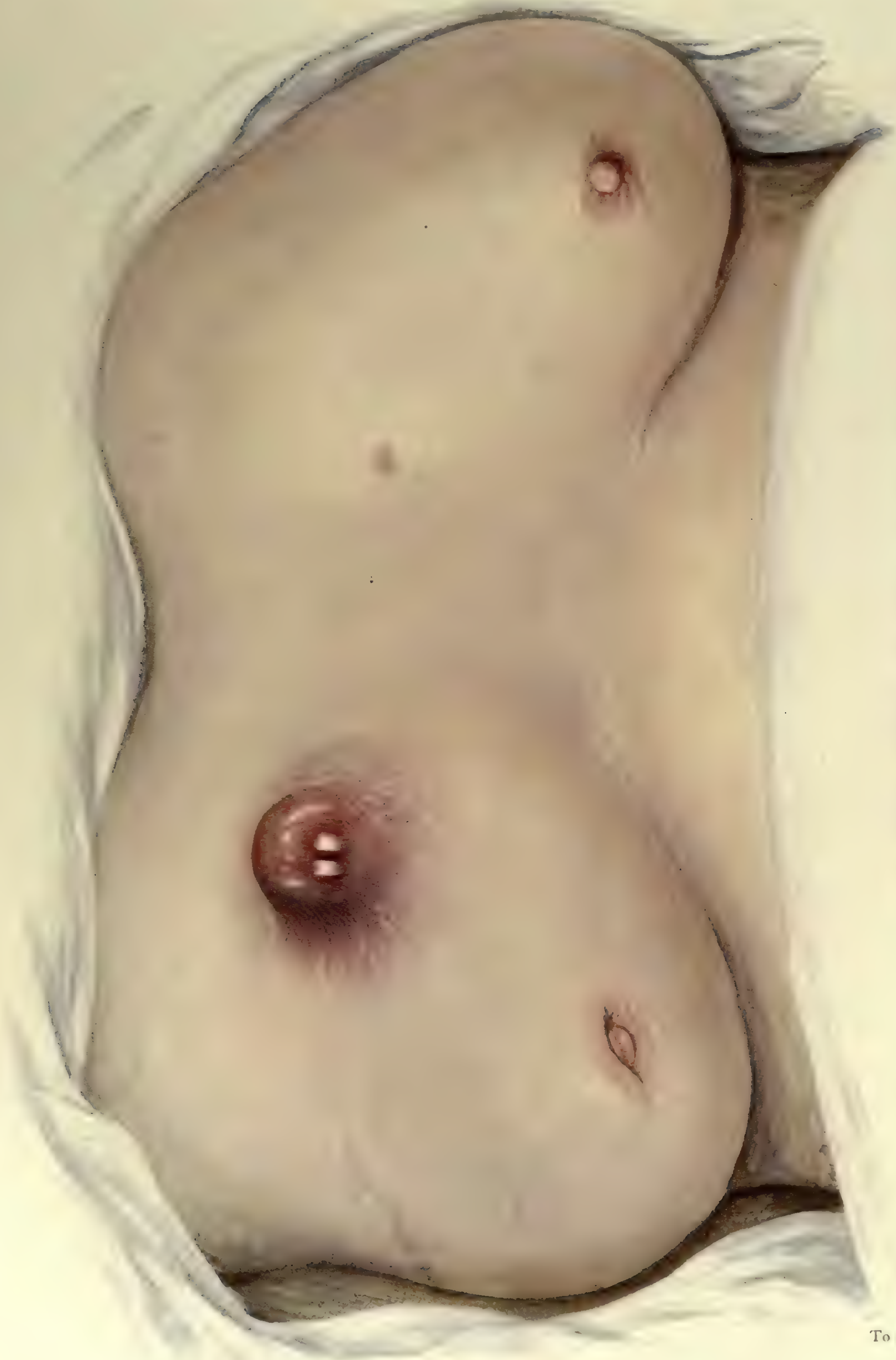
(iii.) Still later an *orange-rind* appearance may be seen, the skin, owing to obstruction to its lymph-return, becoming coarse and pitted like a pig-skin or an orange-rind.

(iv.) Further involvement of the skin may occur, and a condition of *pachydermia carcinomatosa* develop. This is due at first to widespread lymphatic obstruction, but later to definite cancerous invasion of the skin itself ; the condition is then known as *cancer-en-cuirasse.* The skin becomes thickened, stiff and leathery, and does not pit on pressure ; then on its brawny surface purplish-red malignant nodules appear here and there, and perhaps become crusted with desquamating scabs, or soften and ulcerate. The *cuirasse* is most advanced near the original growth, but spreads in a centrifugal manner, and may involve a very wide area.

(v.) Secondary *nodules* may appear (Plate II.), due to invasion of the skin along the suspensory ligaments from the growth, as it permeates along the lymphatics of the fascial sheath. They tend to show a centrifugal distribution, and their presence suggests a gloomy prognosis, as indicating a considerably wider involvement of the pectoral fascia.

(vi.) *Ulceration* through the skin is preceded by adhesion of the growth and infiltration. The skin becomes reddened, then bluish, and cracks or bursts, usually with some haemorrhage. There results a hollowed-out, irregular sore with raised, thickened, projecting, craggy, carcinomatous edges. Unless kept scrupulously clean by antiseptic dressings, its floor becomes sloughy, and the discharge thin, sanious,

Plate II. Vol. III



Advanced Carcinoma Mammæ. Note retraction of the nipple, a large raised nodule about to burst, and a small secondary skin-nodule on the other side.

To face page 52

and very offensive. Haemorrhages are common and may be serious. Ulceration is a late manifestation, and, although not necessarily an indication of inoperability, it materially depreciates the prospects of a cure.

Pain is more common in the later than in the earlier stages, and is often a prominent symptom. In the breast it may be lancinating or throbbing. In the arm it may be due either to brawny lymphatic oedema, or to the pressure of enlarged supraclavicular glands on the brachial plexus; there it may take the form of a constant ache, or of sudden neuralgic paroxysms shooting down the arm or up the neck. Aching pains in the bones or neuralgic manifestations due to spinal involvement often follow metastases in bones or vertebrae.

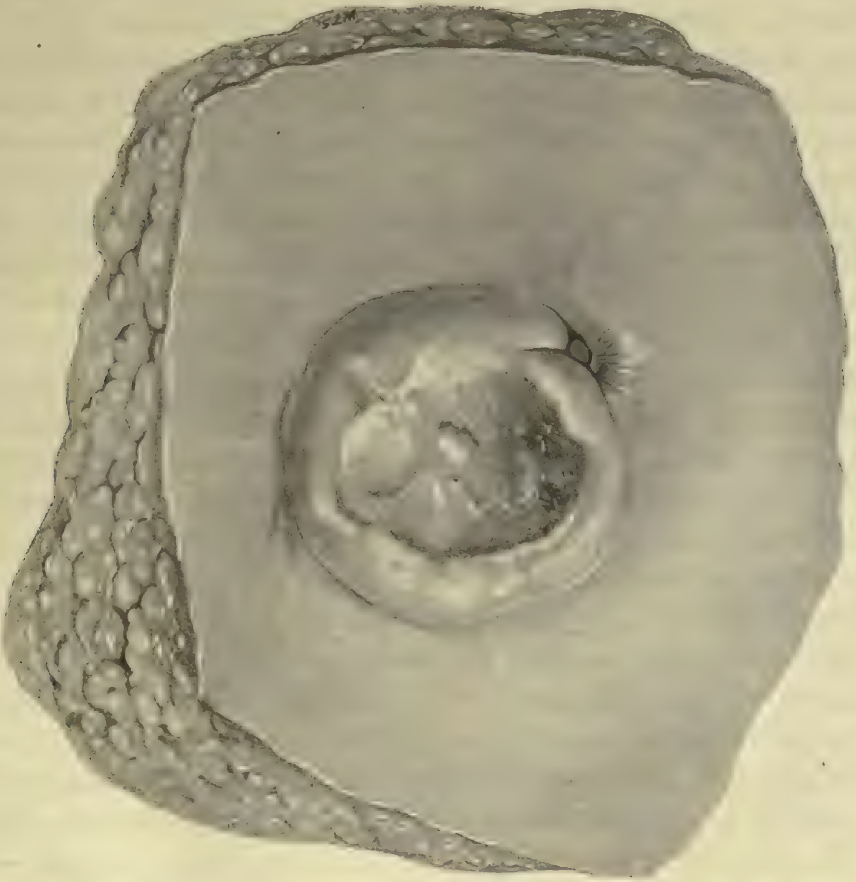


FIG. 17.—Advanced carcinoma showing indrawing of the nipple and a crateriform ulcer. (Museum of The Seamen's (Dreadnought) Hospital.)

Cachexia, wasting, and exhaustion eventually supervene and death ensues.

(*c*) *Complications.*—(i.) '*Brawny Arm.*'—In advanced cases the arm of the same side becomes swollen, puffy and oedematous ; at first it pits on pressure, but later it is firmer and brawny. The swelling becomes extreme, the dragging pain unceasing and intolerable, and muscular power is gradually completely lost. The condition is due to permeation of the lymphatic plexuses of axilla and shoulder, and their subsequent obstruction by perilymphatic fibrosis. It will be seen, therefore, that its presence indicates so wide an extension of the disease that no hope can be given of getting beyond the disease by operation. The condition *per se*, can be relieved by Handley's operation of lymphangioplasty (the implantation of coarse silk threads in the subcutaneous tissues from wrist to scapular and lumbar regions) ; the benefits though not permanent serve to make the patient's last months of life less painful and distressing.

(ii.) *Secondary growths* may arise in distant parts and hasten the end. Affection of the pleura and lungs, the liver either on its surface or within its substance, the pelvic and other abdominal organs, the bones, spine, and brain may, any or all, occur and cause the corresponding symptoms. When the bones are attacked pain of a dull, aching character may be severe ; in other cases the first serious warning may be a spontaneous fracture of the upper half of the humerus, or of the femur at or below the trochanters. Such a fracture may remain un-united, but not infrequently union occurs. Any other bone may be affected, but the sternum, ribs, vertebrae, and proximal ends of femur and humerus are the commonest seats of secondary growth. The neoplasm has an endosteal localization.

B. *Clinical Features of an Atrophic Scirrhus.*—In elderly women a very chronic type of scirrhus is found, in which the fibrotic processes have almost, or even in some instances quite, counterbalanced the tumour cell-growth, the cells being crushed in the dense contracted stroma.

The tumour remains unchanged and painless perhaps for many years as a hard cake in a flattened atrophic breast, attracting no attention until the patient dies from some other cause, until ulceration occurs, or until evidences of secondary growth, such as a spontaneous fracture, manifest themselves. The skin becomes puckered and adherent, the breast is small and flat, and the nipple retracted.

In every case of fracture from 'insufficient violence,' or of visceral tumour in an elderly woman, the presence of an atrophic scirrhus should be excluded.

The prognosis of an atrophic scirrhus is materially better than that of an ordinary *carcinoma mammae*, but sooner or later, generally after a number of years, metastasis is liable to occur. Therefore in all cases in which the general condition of the patient permits, that is in nearly all cases, a radical removal of the breast should be adopted.

A partial interference, in that it may stir up the tumour to more rapid growth, is worse than no operation at all.

C. *Clinical Features of Medullary Carcinoma.*—In this form of cancer, which is especially found in young women, the stroma-reaction is much less advanced than in the ordinary scirrhus, and the neoplasm is markedly cellular. It forms a lobulated, large, comparatively soft mass, of rapid growth and very fatal prognosis. The axillary glands become considerably enlarged at an early stage. The skin soon becomes adherent, infiltrated, and ulcerated, and the cancer protrudes as a dirty, sloughing, fungating mass. Metastatic deposits are common, haemorrhages frequent, and cachexia is a prominent symptom.

Although scirrhus, atrophic scirrhus, and medullary carcinoma have, for the sake of clearness, been described as three definite entities, it must be remembered that all grades are seen between them, and that, as already pointed out, the differences between them depend chiefly on an accidental quality, the degree of stroma-reaction. A full description of the spheroidal-celled carcinoma of acinous origin should cover a field which has atrophic scirrhus at one end, medullary carcinoma at the other, and ordinary scirrhus near the middle.

D. *Clinical Features of Acute Diffuse* (*Multicentric*) *Carcinoma* (*Carcinoma Mastitoides or Mastitis Carcinomatosa*).—In this terribly malignant, but fortunately uncommon, variety the whole breast rapidly becomes infiltrated, probably from several cancerous centres of simultaneous origin. It occurs in otherwise healthy young women, especially in association with lactation. At first it is not infrequently mistaken for a widespread, acute inflammation, for the whole breast is swollen and enlarged, the overlying skin hot, red, and perhaps oedematous, and the superficial veins dilated. The nipple may be swollen and prominent or occasionally retracted. The axillary glands quickly become considerably enlarged. Within a short time the whole skin becomes infiltrated with growth and nodules, and a cancerous *cuirasse* is formed. Metastases occur early, operation is useless, and the patient inevitably dies within a comparatively few weeks.

E. *Clinical Features of Duct-Carcinoma.*—Duct-carcinoma is usually said to be uncommon as compared with cancer of acinous origin, but Cheatle holds that it is much commoner than is usually thought, and believes that many apparently spheroidal-celled growths will, if carefully searched, display here and there cubical cells, evidences that the initial change took place in the smaller ducts near the acini. Tumours of this latter type, the second type described under "Morbid Anatomy" (see p. 45), are with difficulty diagnosable from a scirrhus, and of course their treatment is identical with that of the scirrhus; the distinction is therefore of pathological and perhaps of prognostic rather than of clinical interest.

The more typical clinical features of duct-carcinoma are best seen in cases of the large duct or ' papillomatous ' columnar-celled type. There has often been a history of discharge from the nipple of years' duration, and sometimes evidence of the previous existence of an innocent duct-papilloma may be obtained. Although not essentially present, a sanious discharge from the nipple is of frequent occurrence. A tumour develops in the neighbourhood of the nipple, but retraction of the nipple is rare. This lump on section usually show scysts filled with arborescent papillomatous ingrowths or with sanious cancerous remains. The clinical signs associated with fibrotic contraction and with adherence to skin and fascia may be absent, and the axillary glands are unaffected until a comparatively late period. The disease usually appears in elderly women, and presents a relatively good prognosis ; it must, however, be treated as radically as a scirrhus. Duct-carcinoma and scirrhus may co-exist in the same breast.

Diagnosis of Breast-Cancer.—If the clinical features do not suffice to enable the surgeon to reach a diagnosis, he is justified in removing the whole local tumour for examination if this be possible, or in removing a wedge from its margin. If this plan be adopted, however, and the malignancy of the neoplasm established, radical operation, with an entirely new set of instruments, gloves, and towels, should be undertaken immediately the microscopic examination has been made. Ernest Shaw, in order to shorten the gap between exploratory incision and radical operation, immediately examines frozen sections whilst the operator awaits the decision ; this method is excellent in the hands of a pathologist accustomed to frozen sections, but if such help be not available, the surgeon will be well advised to permit time for an ordinary microscopic preparation, and to complete the operation a day or two later ; the risk that during that period the tumour has been stimulated to growth beyond the bounds of operability is small. Mere incision and examination with the naked eye will often present the appearances mentioned on page 42 so characteristically that doubts as to the character of the growth are settled.

The danger of an overlooked carcinoma is so great, the early diagnosis often so difficult, and the desirability of early operation so obvious, that it is a good practical rule to explore all uncertain mammary tumours in women over thirty. Wherever possible, however, exploratory incision should be avoided, and the radical operation commenced with the tumour buried far from the incisions.

Differential Diagnosis. -It will often fall to the surgeon's lot to differentiate between—

(*a*) Scirrhus and (1) Chronic Mastitis.
,, ,, (2) A tense Cyst with (or without) Chronic Mastitis.
,, ,, (3) A Fibro-adenoma with or without Mastitis.
,, ,, (4) A Fibro-sarcoma.
,, ,, (5) Tuberculosis.
,, ,, (6) Gumma.
(*b*) Medullary Carcinoma and (1) Sarcoma.
,, ,, ,, (2) Cystic Fibro-adenoma.
(*c*) Acute Diffuse Cancer and (1) Acute Mastitis.
,, ,, ,, ,, (2) Sarcoma.

(*a*) (1). The diagnosis between a scirrhus and a patch of chronic mastitis is often very difficult, especially in view of the frequent association of the two conditions. If the chronic mastitis be uncomplicated by the presence of a lump due to a tense cyst, a fibro-adenoma, or a carcinoma, the diagnosis may often be reached by attention to the following points :

A scirrhus is often stony-hard rather than leathery or rubbery in consistence ; it forms a definite tumour attached to the breast-tissue ; its outline is often irregularly rounded and disregards the shape of the mammary lobules. It is single and involves but one breast ; it is not tender, and rarely painful in the early stages in which differentiation is so important and often so difficult. As the disease progresses diagnosis becomes easier ; retraction of the nipple, not seen in uncomplicated mastitis, is common in scirrhus ; the skin becomes adherent, and an orange-rind appearance may follow. The axillary glands may be enlarged in either disease, but are affected more commonly in scirrhus than in chronic mastitis ; in the former they are hard, definitely palpable, but not tender ; in the latter they are often less distinctly palpable, are softer and frequently tender.

(*a*) (2). Differentiation between a scirrhus and a deeply-placed, tense, or thick-walled cyst is often very difficult and only to be made by an exploratory incision. Exploratory aspiration through a hollow needle is unsatisfactory in that although it may prove the presence of fluid, it in no way determines the character of the pericystic tissues. The absence of nipple retraction, of fixation, of axillary lymph-nodules or other evidences of cancer, together with an elastic sensation imparted to the examining fingers, will sometimes settle the diagnosis in favour of a cyst. To determine elasticity the patient should be examined lying down on a firm couch.

(*a*) (3). Although the physical characters will generally distinguish a fibro-adenoma from a carcinoma, cases are not infrequently encountered in which the typical clinical picture of a fibro-adenoma is so obscured by surrounding chronic mastitis that it is impossible to be sure that the condition is not an early and unusually mobile carcinoma ; in such case exploratory operation and microscopic examination are essential.

(*a*) (4). A fibro-sarcoma has a less nodular and more definitely rounded or lobulated shape ; it is not associated with nipple-retraction or puckering of the skin ; the axillary glands are often not palpable.

(*a*) (5) and (6). The later stages of *tuberculous* or tertiary *syphilitic* disease of the breast, when the axillary glands are enlarged and the skin of the breast has become involved, very closely simulate carcinoma ; the glands may be hard and not tender, and the skin may show adhesions to the breast, and even an orange-rind appearance. If the region beneath the nipple is affected, retraction may follow. Usually, however, soon after adhesions to the skin have occurred, the central part of the indurated mass softens and a tuberculous abscess or a gumma bursts. In tuberculosis there may be more than one area of induration. Signs of tuberculosis or syphilis elsewhere, a positive reaction to the Wassermann test for syphilis, or the success of anti-syphilitic treatment, will often aid in diagnosis, but in some cases microscopic examination of an excised part of the swelling is necessary to decide the nature of the case.

(*b*) A medullary cancer may be confused with a sarcoma, or if it has broken through the skin, with a fungating sarcoma or a fungating cystic fibro-adenoma. The physical signs alone often fail as a diagnostic basis, and resort must then be had to the microscope.

(*c*) Acute diffuse carcinoma may closely simulate a sarcoma or an acute mastitis, especially as all three conditions tend to affect comparatively young women, and the carcinoma and the mastitis especially occur during lactation.

The absence of retraction of the nipple, and of dimpling or puckering of the skin may prove of service in separating sarcoma and mastitis from carcinoma ; the axillary glands are usually impalpable in sarcoma, but are soon hard, palpable, and not tender in carcinoma, whilst in acute mastitis they are, if enlarged, usually tender. Obvious enlargement of the superficial veins may be seen in all three conditions, but is perhaps commonest and most marked in sarcoma.

Prognosis.—The prognosis is difficult and depends on many factors, such as the character of the neoplasm, the degree to which it has developed, the rate of its growth, the thoroughness with which extirpation has been carried out, the extent to which lymphatic glands are involved, and the age of the patient. An indication of the relative malignancy of the varieties of tumour has been given in their discussion above. The outlook is most promising in the fibroid types of tumour, in early cases discovered and eradicated before skin and fascia or axillary glands have become affected, and in elderly rather than in young women. The most virulent and hopeless types of cancer occur in young women. According to Halsted two-thirds of the patients in whom radical extirpation is performed before the axillary glands are palpable remain well, but three-fourths of those with infected glands suffer recurrences later and eventually die. The immediate mortality of operation is not more than 2 or 3 per cent.

The results of avoiding operation are almost inevitably fatal ; it is true that cases (notably one recorded by Pearce Gould) have occurred in which for unknown reasons natural cure has happened, and that occasionally a scirrhus of a very fibrotic type will exist in an elderly woman for some years until she dies of some intercurrent affection, but these are so rare that they must cause no variation in the decision that in all operable cases the only justifiable treatment is early and radical operation.

A few cases are inoperable when first seen by the surgeon, notably those in which the growth or the axillary glands are immovably adherent to the thoracic wall, in which there is evidence of secondary growths in distant parts, such as the liver or bones, or in which the growth belongs to the class of acute diffuse cancers.

Other contra-indications to operation are the presence of ' brawny arm,' which denotes widespread lymphatic permeation, the existence of widespread involvement of skin, such as *cancer-en-cuirasse* or of skin nodules " more than 2 inches from the primary growth " (Handley).

Treatment.—Adopting the belief that the chief factor in dissemination is permeation along the lymphatics in the deep fascial plane, as a logical sequence one must plan the radical operation so as to remove a very wide area of deep fascia, sacrificing much more of it than of skin.

The whole breast, with a wider plaque of deep fascia, the submammary muscles, including the pectoralis minor, and the areolar and lymphatic tissues of the axilla, subclavicular region, and, if necessary, supraclavicular triangle must be swept away in a continuous unbroken mass.

The sternal head of the pectoralis major must in every case be removed ; I always also take the pectoralis minor because lymphatics from the breast come into close relationship with it, especially near its lower border, and because its absence facilitates thorough clearance of the axilla and subclavicular space, yet has very little effect upon the subsequent use of the arm. After the radical operation the patient has surprisingly good power of arm-movement, the anterior fibres of the deltoid and the clavicular head of the pectoralis major sufficing for all purposes. In any case in which mere hooking up of the clavicular head of the great pectoral does not give very free access to the subclavicular region, it is wise to remove this part of the muscle too; subsequent movements are quite satisfactory, and the operative facilities gained are sometimes great. When the supraclavicular glands are to be removed temporary division of the clavicle, followed by wiring of the fragments, is sometimes advisable.

The Operation.—Some hours before the operation the axilla should be dry-shaved, the whole operative area cleansed and dried with acetone, and then painted with a 2 per cent solution of iodine in ethyl alcohol or in ethylene dichloride. The field prepared should extend from above the clavicle to the umbilicus, from 2 or 3 inches beyond the middle line to behind the posterior axillary fold, and down the arm as far as the elbow. A dry, sterilized dressing is then applied; at the time of operation this is removed, and the whole area re-painted with iodine.

The best anaesthetic is either C.E. mixture or ether administered by the open method, in either case preceded by a hypodermic injection of morphia (gr. $\frac{1}{6}$th), and atropine (gr. $\frac{1}{100}$th) half an hour beforehand. Although it is true that ether induces more bleeding during the operation, the points can be picked up at once, and the dangers of cardiac complications and of post-operative oozing are less than if chloroform is used. Ether should not be given by the closed method for it then causes risks of congestion of the lungs, which are already chilled by the denudation of the warm muscular and fatty layers of the thoracic wall.

The *skin incision* will vary slightly in shape with the position of the tumour in the breast, but in its essentials it consists of three parts, viz. (*a*) a circle or ellipse having the growth as its centre, and tailing off above into (*b*) an axillary and below into (*c*) an epigastric prolongation.

(*a*) The central part of the incision should take a more or less circular form with the growth, not the nipple, as its centre. Its diameter should be about 5 inches, that is, the point on its circumference nearest to the tumour should be at least 2 inches distant from its apparent edge. As a geometrical circle is not easily sutured at the end of the operation, it is best to tail it off above and below into an ellipse.

If the growth is near one boundary of the breast it is a good plan to convert that side of the ellipse into a triangle with its open base towards the tumour; the wound may subsequently be stitched up in the form of a ⊤. Wide clearance of the growth must never be sacrificed to the desire to fashion incisions that can be completely sutured at the end of the operation; as a rule, wide undercutting of the surrounding skin, or lateral cuts into the outer side, will enable the surgeon to approximate the edges, but the primary object to be gained is wide removal; if this cannot be secured without leaving an uncovered area, skin grafting must be adopted.

(*b*) The axillary tail of the incision runs from the upper end of the ellipse in a curve with its convexity upwards across the anterior fold and outer wall of the axilla.

(*c*) The epigastric portion of the incision passes down from the lower extremity of the ellipse into the epigastric region to a point about half-way between xiphisternum and umbilicus.

As the axillary and subclavicular region is the part where, if anywhere, clearance is liable to be incomplete, it is a good plan to expose the axillary vein in the upper part of the arm at an early period. Then, having soon divided the two pectorals from their insertions, the axilla can be cleared from its apex, and the whole mass dissected downwards. Throughout the operation the assistant grasps the edges of the flaps with hot towels, thus at the same time preserving their vitality and stopping haemorrhage from many small vessels, the clipping of which with forceps would cause unnecessary waste of time.

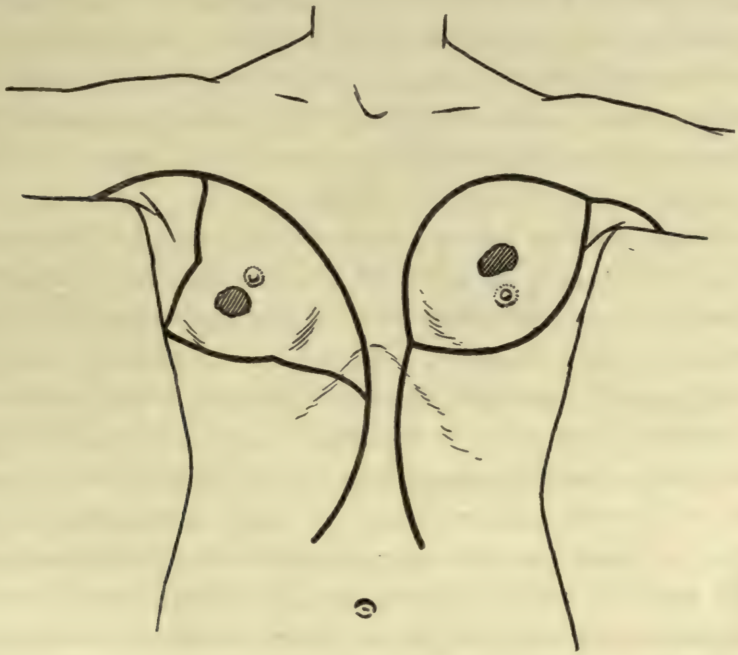


FIG. 18.—Diagram to show two skin-incisions for the radical removal of the breast.

Modifications are of course necessary to meet the distribution of the growth in individual cases, but an average operation may be described as follows:

The incisions having been made as described, the skin of the upper flap is dissected up by a series of cuts made parallel with the surface, and in the middle of the subcutaneous fat. This dissection must be carried above to the clavicle and internally to a point beyond the *opposite* margin of the sternum ; if the neoplasm is in the inner mammary hemisphere the dissection should extend 1 or 2 inches beyond the sternum on to the opposite pectoralis major. Below it should pass across the linea alba on to the opposite *rectus abdominis.* The deep fascia is then divided at the limits of the dissected area, and the process of separating the fascial fringe begun. At this stage the anterior perforating branches of the internal mammary artery of the other side will be divided, and should be ligatured at once, lest their cut ends retract within the chest. The distance to which the deep fascia must be separated on the inner and upper side is determined by the position of the growth ; a circle of deep fascia 10 inches in diameter, with the neoplasm as its centre, must be removed.

At this stage it is a good plan, as Stiles advises, to separate the sternal and clavicular heads of the pectoralis major by blunt dissection, and in the gap so made to expose, hook forward, ligature, and divide the pectoral branches of the acromiothoracic axis, thus cutting off at once a considerable part of the vascular supply of the breast.

Then the infero-external flap is dissected back as far as the posterior axillary fold, or further if necessary to complete the 10-inch circle, and the deep fascia raised from the *serratus magnus, latissimus dorsi,* upper digitations of external oblique, and upper part of *rectus abdominis.* The superficial parts of these muscles are raised with the fascia if necessary. The fibres of origin of the *pectoralis major*, and then of the *pectoralis minor*, are now detached from sternum and ribs, the perforating branches of the internal mammary artery being ligatured as they are cut ; if a branch is cut too short for ligature it may be caught by inserting a suture with a curved needle. A finger may now be passed between the clavicular and sternal portions of the *pectoralis major* near its insertion into the outer lip of the bicipital groove and the sternal head divided there. If the neoplasm is high in the breast, or if retraction of the clavicular head does not afford free access to the subclavicular region, that part of the *pectoralis major* should also be divided. The axillary vein is now readily isolated and cleaned, its sheath being removed with the neighbouring tissues ; the *pectoralis minor* should be detached from its insertion into the coracoid process as soon as possible ; its vessels enter it near its insertion, and are readily caught. This step permits free access to the whole axilla and subclavicular region, and thorough detachment of sheath, fatty, and lymphatic tissue from the whole axillary vein. The entire contents of the axilla should now be dissected *downwards* from its dome towards the central mass of muscle, fascia, breast, and growth. With them the sheath of the axillary vein, the remnants of costo-coracoid membrane, and all the subclavicular tissue should be brought down. Many branches of the axillary vessels will require division with care not to cut them so close to the parent vessels as to leave no firm hold for ligatures. When cleaning the anterior aspect of the subscapularis muscle the long subscapular nerve will be encountered, but usually can be saved ; similarly when cleaning the *serratus magnus*, the posterior thoracic nerve of Bell should if possible be preserved. The fascia should be removed in a complete sheet from the muscles, leaving their fibres naked.

Vessels are then ligatured, a drain inserted into a posterior corner of the wound, and the latter sutured. Difficulties in approximating the edges will usually be met by wide undercutting of the flaps, especially the outer one, and if necessary by making a transverse cut into the outer margin an inch or two below the axilla ; this allows the axillary skin to be drawn downwards and inwards to cover part of the chest-wall.

After Treatment.—Until the first dressing, the arm may with advantage be fixed to the trunk by bandages, leaving the forearm and hand free. On the third day the first dressing is changed, the drainage tube removed, and the bandages now so arranged that the patient can rest comfortably with the arm reclining on a pillow and well abducted from the side, to prevent contraction of the axillary scar and consequent limitation of movement.

As soon as the wound has healed, massage should be initiated to resist still further any tendency to binding down of the arm. It is also advisable to subject the patient to a course of X-ray exposures to endeavour to discourage recurrence of the growth.

Treatment of Inoperable Cancer of Breast.—Much can be done by means of antiseptic dressings to relieve pain, to reduce discharge, and to overcome foetor in cases in which an open ulcer exists.

Pain and sleeplessness call for the exhibition of analgesics ; morphia should only be used when less toxic agents, such as aspirin and phenacetin, have failed.

In women of menstrual age, oöphorectomy has been recommended by Beatson as a means of retarding the rate of growth of the mammary carcinoma, but its results are very disappointing.

The results of radium-therapy for inoperable mammary cancer have in my experience been disappointing.

Endothelioma of the Breast

Endotheliomata of the breast are probably more common than is usually believed ; possibly some of the tumours classified as alveolar carcinomata really originate in the endothelium of blood-vessels or lymphatics, and therefore belong to this group. They can only be differentiated from carcinomata with the help of the microscope. Their prognosis is probably better than that of the carcinomata, but the treatment is the same, namely radical removal of breast, fasciae, muscles, and axillary contents.

Sarcoma of the Breast

Mammary sarcoma is a rare condition, certainly not accounting for more than 2 or 3 per cent of all malignant growths in the breast. Although it may occur at any age it most commonly affects women between 30 and 50. A definite injury is often held to be responsible for its origin, and Coley has adduced many cases in which a close relationship seems probable. It has been stated that a fibro-adenoma may become converted into a sarcoma, the soft fibro-adenoma being an intermediate step, but for this suggestion there is very little definite evidence.

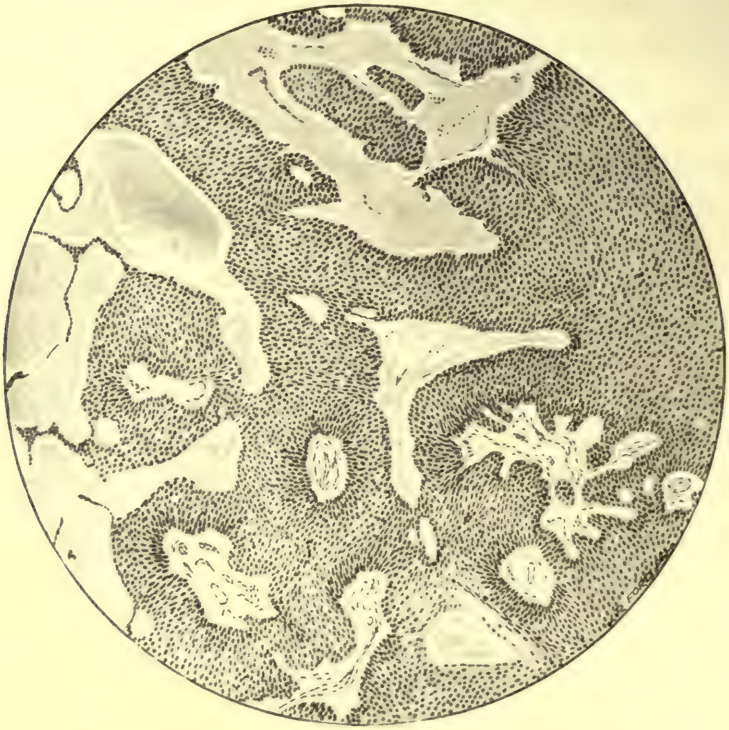


Fig. 19.—Endothelioma of the breast. (Cuthbert Lockyer's.)

Pathology.—The growth may belong to one of three varieties :

(*a*) Fibro-sarcoma or spindle-celled sarcoma, of relatively slow growth and less malignant type.

(*b*) Round-celled sarcoma, rapidly growing and comparatively soon causing metastases elsewhere in the body. Myxomatous and cystic degeneration are not infrequently seen, the cysts being formed by haemorrhagic extravasations or occasionally by dilatation of epithelium-lined alveoli trapped in the growth.

(*c*) Chondro-sarcoma. This rare variety contains islands of cartilage, which may undergo calcification or even ossification. It is not necessarily less malignant because partly cartilaginous.

A sarcoma forms a rapidly-growing mass in the breast-tissue ; it quickly causes enlargement of the breast without producing retraction of nipple or contraction of tissues such as that seen in connection with scirrhus.

At first the lump may be small and fibroid, but it may early burst through its capsule and infiltrate widely through the mammary gland. The round-celled variety is perhaps the commonest and often develops into a very large tumour.

The lymphatic glands of the axilla are involved late in the disease and may escape altogether.

Clinical Features.—A rapidly-growing tumour appears in the breast ; although, especially in the fibro-sarcomatous variety, perhaps at the first suggestive of a fibro-adenoma, the swelling soon reaches a large size and a hemispherical shape. The breast becomes prominent, and its superficial veins greatly enlarged ; the axillary glands are usually not palpable, the nipple not retracted and the skin not tacked down. The edges of the tumour are not usually nodular, but rather smooth or lobulated. Its consistence may be even, or softer areas here and there may indicate the presence of cysts. Pulsation is occasionally to be observed.

Sooner or later the growth becomes adherent to pectoral fascia and to skin ; then the latter becomes red and thin, and finally gives way allowing the sarcoma to fungate through as a reddened, haemorrhagic, and perhaps sloughy mass.

Sarcomatous emboli may be carried in the blood-stream to distant organs, there to originate metastatic deposits. Often, however, the patient dies of haemorrhage from the tumour, or of asthenia before metastases have developed.

The *diagnosis* has been discussed under carcinoma (see p. 56).

Treatment.—Sarcoma calls for early and radical operation similar to that adopted for carcinoma. The axilla must be cleared in all cases, even in the frequent cases in which no glands are palpable.

THE VERMIFORM APPENDIX

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The vermiform appendix, although a vestigial and so far as we know a functionless structure, has gained an unenviable notoriety owing to the frequency with which it is affected with serious disease. In England and Wales alone, 2730 persons die every year from appendicitis. Indeed it is stated that the mortality rate from appendicitis in persons between the ages of 10 and 25 years exceeds that of all other diseases together.

The Anatomy of the Appendix

Situation.—The appendix is a blind diverticulum from the caecum, situated most commonly on its inner and posterior aspect, one inch from the ileo-caecal valve. In the foetus the appendix is situated at the apex of the caecum, and in some instances this foetal type persists through life.

If a line be drawn from the umbilicus to the right anterior superior spine of the ilium, the point at which this line crosses the outer border of the rectus (about 2·6 inches from the anterior superior iliac spine) is immediately over the ileo-caecal valve (Munro). Usually the appendix is situated 1 inch below this point. The length of the appendix varies considerably. The average length is 3½ inches, but I have removed an appendix measuring close on 10 inches.

The appendix has a mesentery of its own, the meso-appendix, a fold of peritoneum which is continued over the appendix, so investing it with a peritoneal covering. In the meso-appendix run the blood-vessels, lymphatics, and nerves which supply the structure. The appendix derives its blood-supply from the appendicular artery, a branch of the posterior ileo-caecal artery. Veins accompany the arteries and convey the venous blood into the portal system. Numerous lymphatics run with the blood-vessels, and drain into a gland which is usually found at the ileo-caecal angle. The nerves supplying the appendix are derived from the inferior mesenteric plexus of the sympathetic system.

Structure.—The appendix is made up of four layers or coats :

(1) The mucous layer or mucosa, consisting of lymphoid tissue with tubular glands and lymph-follicles. Next the lumen is a single layer of columnar epithelium, on a thin basement membrane.

(2) The submucous layer or submucosa, composed of connective tissue in which run the blood-vessels, lymphatics, and nerves.

(3) The muscular layer or muscularis, consisting of a longitudinal and a circular layer of muscular fibres.

(4) The peritoneal coat or serosa, a layer of peritoneum continuous with the peritoneum forming the meso-appendix.

Peritoneal Fossae.—In the neighbourhood of the appendix there are certain pouches or fossae formed by reflexions of the peritoneum. There are three of these fossae—the ileo-colic, the ileo-caecal, and the retro-caecal fossae. They are of importance because, instead of lying free in the peritoneal cavity, the appendix may occupy one of them. When this is the case, most commonly it is the retro-caecal pouch in which the appendix is found.

When an inflamed appendix is hidden away in one of these, its discovery and removal may be a task of considerable difficulty. Cases of this kind, in which the surgeon failed to find the appendix, have been described erroneously as instances of absence of the appendix.

Diverticulum of the appendix is an uncommon pathological condition. McCarty and McGrath found it 17 times in 5000 specimens examined. As a rule a diverticulum consists of a hernia of the submucosa, muscularis mucosa, and mucosa through an opening in the muscular coats. The outer surface of the diverticulum is covered with peritoneum.

Function.—Nothing definite is known as to the function of the appendix. R. Robinson,[1] as the result of experiments and clinical observation, has come to the conclusion that the appendix is an organ which secretes a hormone to stimulate the caecum, and he believes that the hypothesis that the appendix is the vestigial remains of a large caecum is erroneous. Experiments by Savini[2] confirm these observations.

[1] *Gazette des Hôpitaux*, Nov. 13, 1913.

[2] Savini, *Brit. Med. Journ.* (epitome), July 25, 1914.

APPENDICITIS

By appendicitis is meant inflammation of the appendix. When once the appendix has been affected by inflammation not only is the process of recovery slow and imperfect, but such attacks are very apt to recur. The inflammatory process may be limited to the mucosa or may affect all the coats of the appendix. The inflammation may be of a simple catarrhal type, or it may be so acute as to result in gangrene of a portion of, or of all, the appendicular wall.

Several circumstances help to explain the poor recuperative power of an inflamed appendix. In the first place, it is a vestigial organ, and, like other vestigial structures, has a poor blood-supply. Secondly, the swelling of the mucosa may obstruct the communication with the caecum, so that the inflammatory products are retained under tension in the lumen of the appendix, and keep up the inflammation. Similarly the presence of faecal concretions may keep up irritation. The lumen of the appendix may also become obstructed by kinking or by adhesions. Thirdly, owing to the narrowness of the attachments of the appendix, it must be difficult, even under normal conditions, for the lymphatics and veins to empty themselves freely; when, in addition, the vessels are constricted by inflammatory exudation, this difficulty must be much greater.

There are several reasons why attacks of appendicitis are apt to recur. First, the mucosa may be damaged permanently and so will be less able to resist the subsequent invasion of micro-organisms. Secondly, appendicitis not infrequently results in a cicatricial constriction of the lumen, so that faeces, while gaining entrance into the appendix, do not readily get out again, and so remain as a septic focus. Thirdly, as the result of a previous attack the appendix may be permanently enlarged and its lumen dilated, so that it more readily harbours faecal concretions.

Age-Incidence.—Appendicitis is rare in infants, common in young adults, fairly common in middle life, rare in old people.

The Etiology of Appendicitis.—Much has been written as to the etiology of appendicitis, but as yet it is not possible to say anything very definite on this subject. There can be little doubt that the presence of faecal concretions in the appendix is an important factor in the causation of appendicitis. This hypothesis has been elaborated by Talamon, who believes that if the lumen be obstructed by faecal concretions, the wall of the appendix contracts and the glands of the mucous membrane become hyperactive and secrete an excess of fluid. As the fluid cannot escape readily it dilates the lumen, presses on the blood-vessels, and so interferes with the circulation. Further, the retained fluid forms a favourable medium for the growth of bacteria, the virulence of which is increased if the fluid be retained under pressure. Apart from obstruction, the continued presence of a foreign body in the appendix, or of a faecal concretion, or even of faeces, may produce erosion of the mucosa which allows of the entrance of micro-organisms into the deeper layers of the mucosa.

Arbuthnot Lane regards appendicitis as a result of intestinal stasis. There can be little doubt that stagnation of faeces in the neighbourhood of the caecum, by leading to catarrh, which spreads into the appendix, must predispose to appendicitis. On the other hand there are grounds for the belief, as will be shown later, that in many instances the intestinal stasis is secondary to appendicular disease.

Some authorities maintain that a meat diet predisposes to appendicitis. In 1904 Lucas-Championnière investigated this subject, and found one case of appendicitis in 22,000 Roumanian peasant patients, who live chiefly on vegetables, while among the city-dwelling Roumanians, who live chiefly on meat, he found one case of appendicitis in every 221 patients. The rarity of appendicitis among the Japanese, the natives of India, and the Arabs, all of whom live on a vegetarian diet, is well known. Probably it is not any special virtue of the diet beyond the circumstance that it is a preventive of constipation.

J. F. Briscoe[1] points out the infrequency of appendicitis in asylums. He attributes this to the attention paid to the intestines of the inmates. Their food is carefully prepared and macerated beforehand, and constipation is always guarded against. This is the reason why appendicitis is so uncommon.

The Bacteriology of Appendicitis.—The most common micro-organism found in appendicitis is the *bacillus coli communis.* Next in order of frequency are the *staphylococcus pyogenes aureus* and *albus,* streptococcus, and pneumococcus. In cases of rapidly spreading peritonitis the streptococcus is the micro-organism most often present. In tubercle and actinomycosis of the appendix the micro-organisms distinctive of these diseases are present.

ACUTE APPENDICITIS

Morbid Anatomy.—In acute appendicitis the condition found varies according to the acuteness of the pathological process and to the duration of the disease. In the very early stage there may be a simple catarrhal inflammation, affecting the mucous membrane only. The mucosa is slightly reddened and instead of being smooth is slightly rugose owing to oedema. At first sight the exterior of such an appendix

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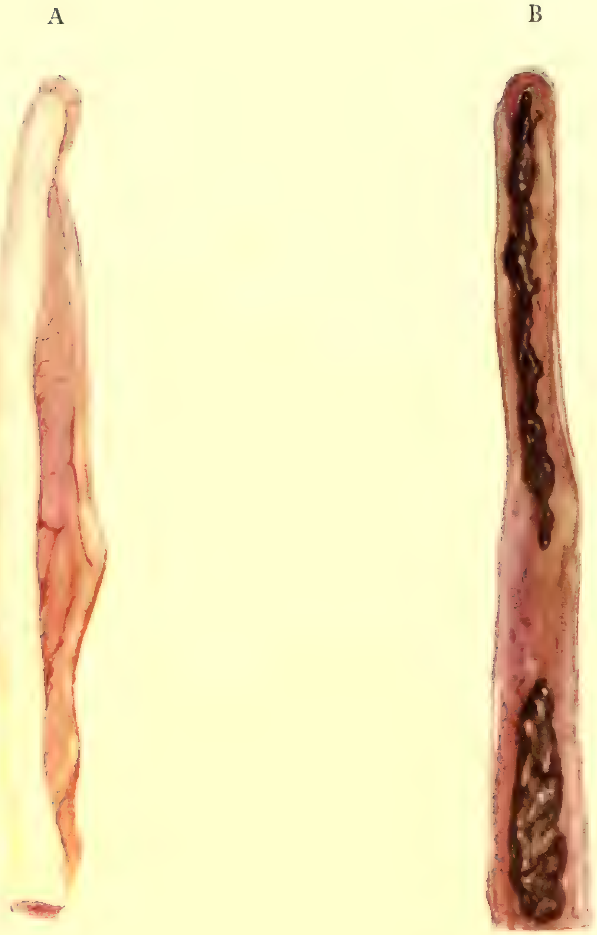
[1] *British Medical Journal,* July 20, 1912.

PLATE III. Vol. III.

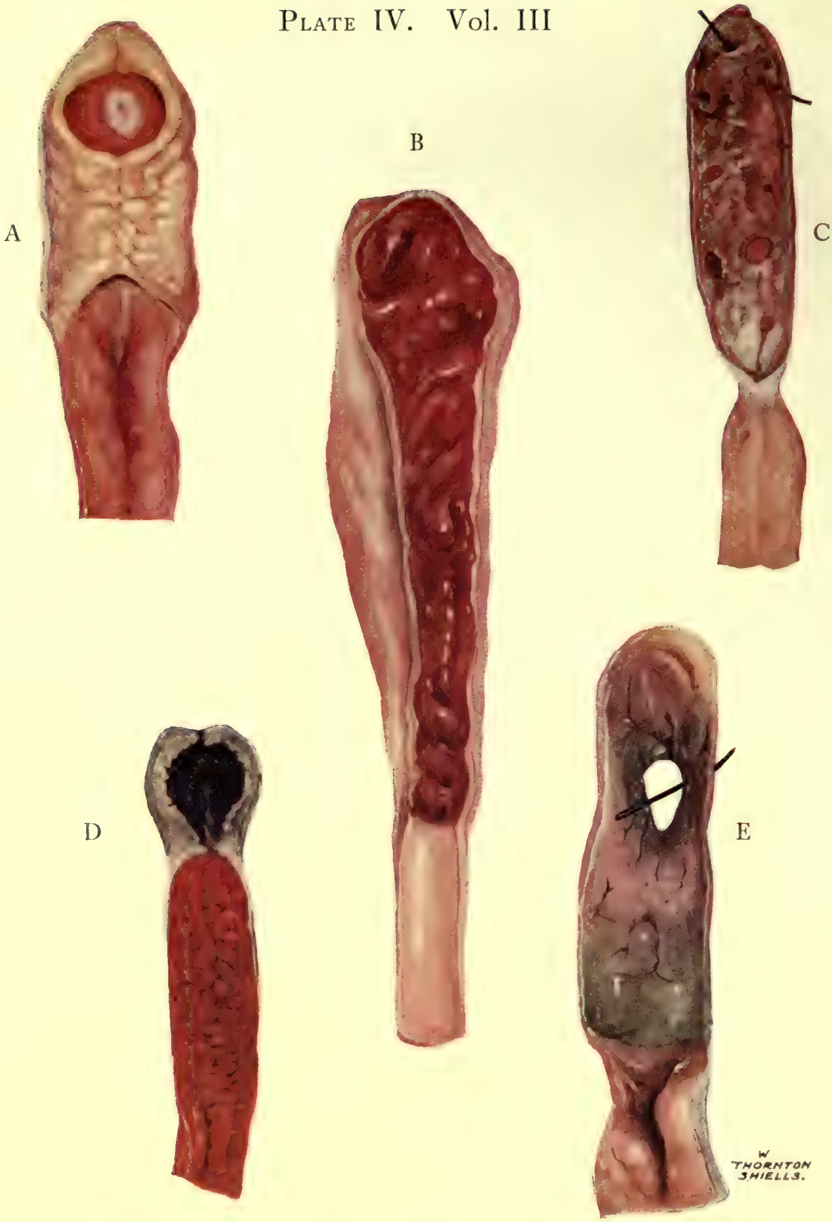


The exterior and interior of an appendix from an officer invalided from the front on account of a mild attack of acute appendicitis.

A. The external appearance of the appendix. The appendix appears to be normal except that there is slight injection of the peritoneal vessels.

B. The same appendix laid open. The whole of the mucosa is still inflamed (three weeks after the acute attack), the distal portion of the appendical lumen is filled with fæces, there is a concretion at the cæcal end, and in one area near the middle of the appendix, there are minute ulcers of the mucous membrane.

PLATE IV. Vol. III



A. An appendix from a case of acute appendicitis. Note the petechial hæmorrhages into the submucosa; visible through the mucosa as confluent red areas. Towards the distal end the appendical wall has been only partially divided, in order to show the thickening of the wall from previous attacks.

B. From a case of acute appendicitis of about ten hours duration. The mucosa is acutely inflamed, markedly œdematous and of an intense red colour.

C. An appendix perforated by an acute attack of appendicitis. There is general ulceration of the mucosa which has resulted in a minute perforation, through which a bristle has been passed.

D. An appendix from a boy who had been ill for four days with acute appendicitis. The tip of the organ is seen to be completely gangrenous, and it was surrounded by a small collection of pus free in the peritoneal cavity. The remainder of the mucosa is acutely inflamed.

E. From a case of acute appendicitis. There is an ashy-grey gangrenous patch at the base of the appendix, and a gangrenous patch near the distal end. Sloughing has occured resulting in a large perforation. Note the old-standing constriction of the lumen near the base of the appendix.

may not suggest that anything is amiss, but on close examination it will be noticed that the surface blood-vessels are injected, and palpation may detect an abnormal rigidity of the appendix due to the swelling of the mucosa and to distension of the appendical lumen.

This is a point on which I desire to lay special emphasis, namely that sometimes it is quite impossible to assert that an appendix is not diseased until it has been laid open and the interior examined. I have heard scoffers in the operation theatre whisper, "He has removed a normal appendix." Such a remark can only be made by those without practical experience of living pathology. An appendix which at a distance of a few feet looks quite healthy may be the seat of very serious disease, and occasionally even a close inspection does not give any indication of the mischief within. This is illustrated in the Figures in Plate III., which shows the exterior and interior of an appendix removed from an officer who was invalided from the front on account of a mild attack of acute appendicitis. At first sight, except for its length, the appendix looks normal. There is, however, on close inspection, a slight injection of the peritoneal blood-vessels (Plate III. Figure A). After the sketch of the external appearance had been made, the appendix was opened, and the interior is shown in Figure B. The mucosa is inflamed, the distal part of the appendical lumen is filled with faeces, there is a concretion at the caecal end, and in one area near the middle there are minute ulcers of the mucous membrane.

At a later stage there may be petechial haemorrhages into the submucous coat, which are visible through the mucosa as punctate or confluent red areas (see Plate IV. Figure A). In more acute cases the whole of the mucous membrane may be acutely inflamed, markedly oedematous, and of an intense red colour (see Plate IV. Figure B). The inflammation is no longer limited to the mucosa, but extends into the other coats of the appendix. Externally such an appendix shows marked evidence of the condition within. The surface blood-vessels are so markedly injected that the organ is of a dusky red colour, its diameter is enlarged, and it feels thickened and indurated on palpation.

In severe cases the inflammatory process may be so intense that there is local or general ulceration of the mucous membrane. The ulceration may extend through all the appendical coats, and result in a perforation which allows of the escape of the contents of the appendix into the abdominal cavity (see Plate IV. Figure C).

In other cases there may be gangrene of a small portion (Plate IV. Figure D), of the greater part (Plate IV. Figure E), or of the whole of the appendix.

These then are the four common types of acute appendicitis—simple catarrhal inflammation, acute inflammation, ulceration, and gangrene. It must be understood that these types are simply different degrees of the same pathological process. Pathologically, acute appendicitis is an inflammation due to a micro-organism. The inflammation may be mild and run a slow course, so that after a duration of several days it may be still of the catarrhal type; on the other hand it may progress so rapidly that gangrene ensues speedily. I have seen the whole appendix gangrenous within ten hours of the initial seizure.

The rapidity and extent of the gangrene depends on two factors. First, the virulence of the micro-organism. Secondly, the degree of tension of the inflammatory products within the lumen of the appendix. Pus-toxins are absorbed more rapidly when under tension. Further, the tension of the retained inflammatory products within the unyielding appendix causes pressure-anaemia of the appendicular walls, so that their vitality is impaired and they yield more quickly to the destructive effect of the micro-organisms. In some cases the gangrene is limited to the tip of the appendix (see Plate IV. Figure D). Probably this local gangrene is due to thrombosis or embolus of the terminal artery. In other cases the whole appendix from tip to base is gangrenous. Sooner or later the gangrenous tissue gives way, allowing the contents of the appendix to escape into the peritoneal cavity. Local ulceration or gangrene may be determined by the pressure of a faecal concretion. In such cases perforation is apt to occur early.

When perforation of an inflamed or gangrenous appendix ensues one of two things may happen. The escape of the appendical contents into the general peritoneal cavity may set up a diffuse spreading peritonitis. Fortunately, however, in many cases in which perforation occurs, the destructive process has taken place sufficiently slowly to allow of the formation of protective adhesions around the appendix. Thus the inflammatory products which escape from the appendix are surrounded by limiting adhesions, which confine the appendical contents to the neighbourhood of the appendix. The escaped inflammatory material excites inflammation in its new situation and so results in a localized abscess (Fig. 20).

The *situation* of such an abscess depends on the position of the appendix. The chief situations in which an abscess may be found are as follows :

1. When, as is most commonly the case, the appendix is attached to the inner and posterior aspect of the caecum, the abscess is situated among the coils of the ileum adjacent to the caecum. Thus the inner wall of the abscess is formed by coils of matted small intestine, while to the outer side it is bounded by the caecum.

2. When the appendix hangs over the brim of the pelvis, an abscess which results from acute appendicitis is situated in the pelvis. Such an abscess is bounded to the

left by the colon and rectum, to the right by the caecum and appendix, above by matted coils of ileum, and below by the pelvic floor (see Fig. 21).

3. When the appendix is directed outwards so that it lies to the right of the caecum, suppuration following acute appendicitis is situated between the caecum and the lateral abdominal wall (see Fig. 22).

4. When the appendix is retro-caecal, pus may find its way to the connective tissue over the iliac muscle behind the peritoneum, forming an extraperitoneal abscess.

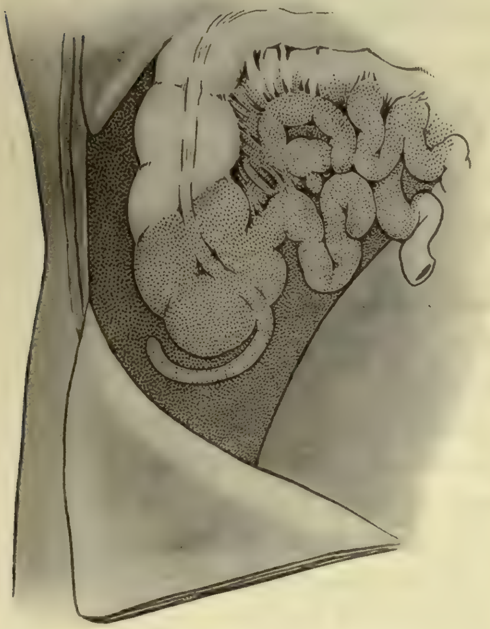


Fig. 20.—A localized appendical abscess. (After Murphy.)

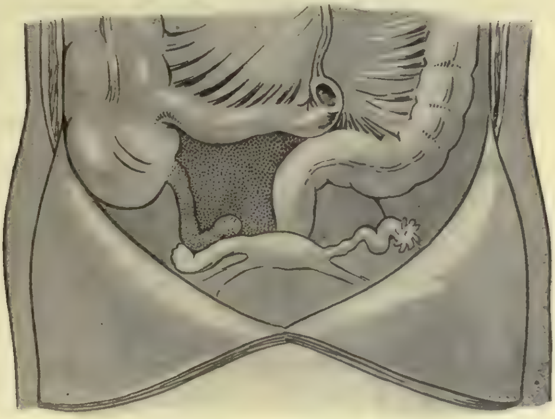


Fig. 21.—Pelvic appendical abscess. (After Murphy.)

5. In some cases in which there is ulceration of the mucosa of the appendix, the retained pus finds its way into the meso-appendix, which is the line of least resistance. This results in a meso-appendical mesenteric abscess (Fig. 23).

When, as the result of acute appendicitis, a localized abscess is formed as described above, one of six things may happen if it be not treated surgically :

1. The abscess may burst into the peritoneal cavity. Fortunately this is a rare occurrence, if the patient be kept at rest in bed.

2. The abscess may drain into some part of the intestinal tract.

3. The pus may find its way gradually through the abdominal wall.

4. The abscess may remain encapsuled for weeks or months.

5. The pus may be more or less completely absorbed.

6. The pus may track slowly in various directions, thus forming secondary abscesses. (*a*) Thus, when there is a localized abscess among the coils of the lower ileum, the pus may gradually find its way through the intestinal adhesions and track across the abdomen, and lead to a secondary abscess between the sigmoid and the great mesentery (see Fig. 24). As the pus in the original abscess is under tension it sets up plastic peritonitis outside its boundaries, so that the track formed by the pus is shut off from the general peritoneal cavity. (*b*) When the abscess is in the pelvis it may ascend on the left side to the outer side of the sigmoid and form a secondary abscess internal to the left anterior superior spine of the ilium (see Fig. 25). (*c*) When the abscess is on the outer side of the caecum it may track upwards to the sub-phrenic space and cause a secondary sub-phrenic abscess. (*d*) The pus may track between coils of intestine owing to yielding of recently formed adhesions until it reach a spot where further progress is barred, and may then accumulate, forming a secondary abscess among the intestinal coils at some distance away from the original abscess.

Symptoms.—The symptoms of acute appendicitis are : abdominal pain, a feeling of sickness or vomiting, right-sided abdominal tenderness, rise of temperature, leucocytosis, and later a swelling in the right iliac fossa.

The onset of acute appendicitis almost invariably is sudden. Without warning, while following her usual vocation, or even while asleep in bed the patient is seized with abdominal pain. The severity of the pain varies ; it may be such that the patient is doubled up with it, but it is rarely of the agonizing intensity of that which accompanies perforation of a hollow viscus. At the onset the pain is frequently referred to the umbilicus or to the epigastrium, but soon it becomes localized to the right iliac fossa. At first the pain is cramp-like or colicky in character, but later its severity diminishes, although from time to time there may be acute exacerbations. The initial pain is probably due to peristaltic movements of the intestine in the neighbourhood of the inflamed appendix. The secondary pain is due to the spread of the inflammation to the peritoneal investment of the appendix.

Vomiting.—Generally the onset of pain is accompanied by nausea and often by vomiting. This is probably of reflex origin, Nature's efforts to empty the stomach and so prevent food reaching the neighbourhood of the inflamed appendix. In the later stages, if the vomiting become more copious and frequent, it may be an indication of spreading peritonitis.

Abdominal Tenderness.—At first there may be tenderness all over the abdomen, although more distinct in the region of the appendix. When the appendix becomes

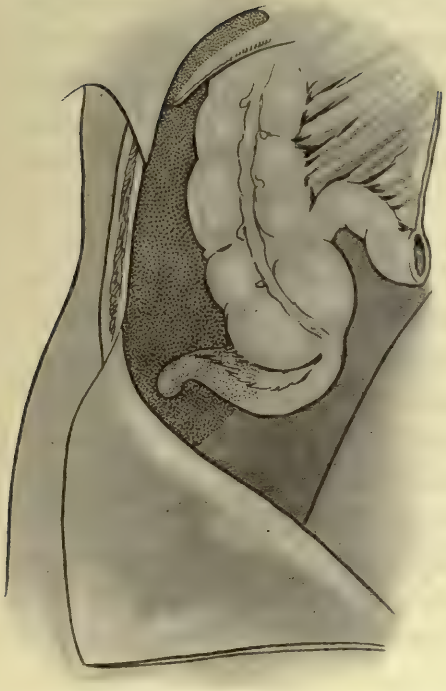


Fig. 22.—Localized appendical abscess to right of caecum. (After Murphy.)

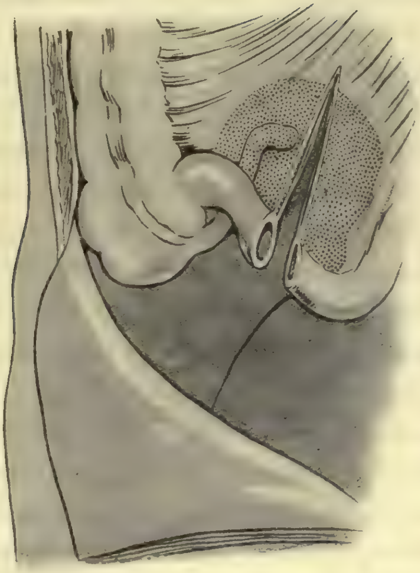


Fig. 23.—Meso-appendical-mesenteric abscess. (After Murphy.)

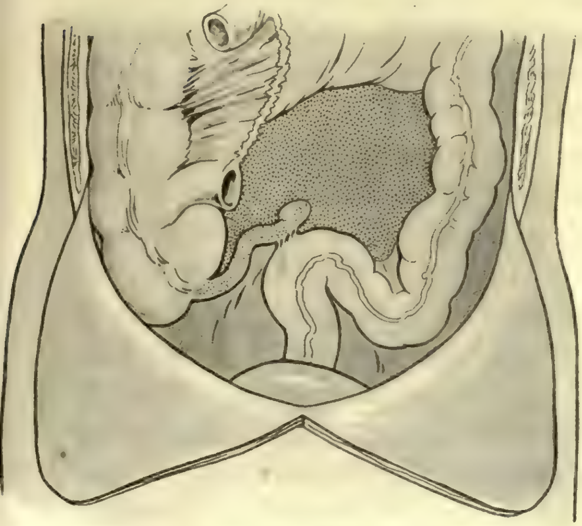


Fig. 24.—Secondary appendical abscess between sigmoid and great mesentery.

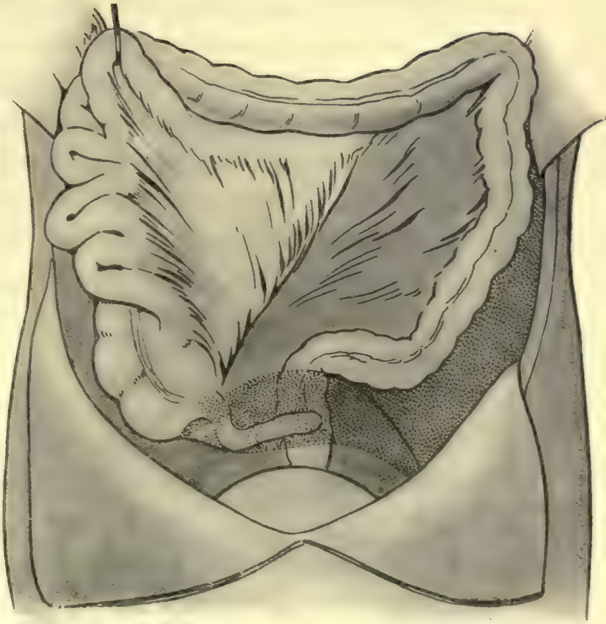


Fig. 25.—Secondary appendical abscess to outer side of sigmoid. (After Murphy.)

tense with inflammatory products there is rigidity of the overlying rectus muscle due to protective spasm, Nature's effort to protect the inflamed organ from pressure. Gradually the general abdominal sensitiveness disappears and tenderness to pressure is limited to the appendix-area. If after this stage has been reached there is a sudden increase of the area of tenderness, accompanied by exacerbation of the pain, it is indicative of perforation or of the yielding of protective adhesions, and may be the beginning of spreading peritonitis.

Temperature.—Coincidently with the onset of pain, or following it a few hours later, there is a rise in temperature. The extent of this varies within considerable limits. In some instances the temperature may not be more than 99° F., or 100° F., in others it may rise as high as 102° F., or even 105° F. In a few cases (especially in children) the rise in temperature may be accompanied by a rigor. After the initial rise there may be a gradual fall in the temperature, succeeded later by a further rise, indicating absorption from pent-up inflammatory products in the appendix, or the spread of the inflammation to its peritoneal covering. Later, there may be a sudden drop in the temperature due to the escape of the inflammatory products through a perforation. A sudden drop in the temperature, especially when accompanied by a sudden cessation of pain, is always a grave sign, and may be the herald of commencing general peritonitis.

The Pulse.—As a rule the pulse follows the temperature, but not invariably. If the rise in temperature be slight there is little or no increase in the pulse rate. If, however, the temperature be much raised there is usually a corresponding increase in the pulse rate, but it is important to bear in mind that a patient may have a severe acute appendicitis with little or no increase in the frequency of the pulse rate.

Leucocytosis.—Acute appendicitis is usually accompanied by leucocytosis. It is a symptom which is sometimes of use in the differential diagnosis of doubtful cases. Too much importance must not be attached to it; it is only of value when it is corroborative of the clinical diagnosis.

Swelling.—In the early stages of acute appendicitis the protective spasm of the right rectus may be so marked that it gives the sensation of a definite swelling. When the patient is anaesthetized the swelling is no longer felt. In the later stages of the disease there may be a definite swelling due to matting of the intestine round the inflamed appendix or round a small collection of pus. The size of the swelling is not necessarily an indication of the amount of pus present. There may be a large apparently fluctuating swelling, but operation reveals only a few drachms of pus. In neglected cases there may be a circumscribed abscess containing half a pint or more of pus, extending into the loin and occupying a considerable part of the abdomen.

Haematemesis is a rare symptom of acute appendicitis. I have observed it once; a young lady aged twenty-five was seized suddenly with severe abdominal pain, and shortly afterwards she had severe haematemesis. A diagnosis of gastric ulcer was made. When I saw her three days later she had a general peritonitis, evidently due to a perforated appendix—a diagnosis confirmed by operation. She made a good recovery and had no further symptoms referable to the stomach.

There are two signs almost invariably present in acute appendicitis, to which for some years I have been in the habit of attaching considerable importance.

1. If the abdomen be inspected carefully it will be observed that the right superficial circumflex iliac and epigastric veins are much more distinct than the corresponding veins on the left side. The value of this sign is not generally appreciated although attention has been called to it by J. Blair.[1]

2. If the two recti abdominis muscles be palpated simultaneously a distinct difference can be detected in the tension of the two muscles.

The Course of Acute Appendicitis.—With absolute rest in bed and abstinence from solid food the majority of patients suffering from acute appendicitis recover. The pain diminishes gradually, the rigidity disappears, the temperature falls by degrees and becomes normal in from three to ten days, and the local tenderness subsides.

This is the course of events in the majority of instances, but in an individual case it is quite impossible from any known signs or symptoms to predict whether recovery will ensue or whether the disease will follow some less favourable course. In some cases the inflammation is so acute that within twenty-four or even twelve hours the whole or part of the appendix is completely gangrenous. I have operated within a few hours of the initial seizure on patients whose symptoms suggested a very mild attack, the pain had subsided gradually after its onset, the temperature was only slightly raised, there was no rigidity and only very slight tenderness, and yet operation revealed a gangrenous appendix with no attempt at localizing adhesions. In such cases a fatal issue from spreading peritonitis is inevitable. It is often said that a completely gangrenous appendix may be shut off by the formation of protective adhesions, and in proof of this it is stated that in operations during a quiescent interval after the attack the appendix in many cases cannot be found. It is inferred that it has been destroyed during the previous attack. This is one of those mythical beliefs that are handed down from text-book to text-book, and which have little foundation on fact. Failure to find the appendix is one of the rarest events, and when it does occur it is probable that it is not because there is no appendix, but because it is retro-caecal or buried in adhesions.

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[1] *British Medical Journal*, June 14, 1913.

In another type of case the malady appears to be running a favourable course, when suddenly there is an exacerbation of pain accompanied by a secondary rise of temperature, due to the accumulation of inflammatory products within the appendical lumen. When pus is pent up under tension within the body there is rapid absorption of toxic products, and destruction of the surrounding tissues. The mucosa therefore becomes ulcerated and the disease may then terminate in one of several ways.

1. The virulence of the toxins may be so great, and the dose absorbed so large, that the patient succumbs from a profound toxaemia. Although the temperature falls gradually, the patient's general condition changes for the worse, her skin becomes sallow or even jaundiced, she is lethargic and later comatose, the pulse gradually fails, and death ensues from general poisoning. In appendicitis a falling temperature, unless it is accompanied by a corresponding improvement in the patient's general condition, is a danger signal, and suggests a grave prognosis.

2. With the destruction of the mucosa, septic infection may spread to the other appendical coats, and set up suppuration around the appendix. When infection gains an exit from the interior of the appendix one of two events happens—(*a*) If the patient's power of resistance be good, by the time pus is formed outside the appendix, a barrier of protective adhesions will have been developed, so that the pus is contained in a localized abscess-cavity. In such a case the temperature, instead of falling, gradually shows a slight rise and then remains between 100° and 101° F., rigidity and resistance in the right iliac fossa become more marked, and after a few days a definite swelling can be detected. This swelling is caused by the matting together of intestine and omentum round the abscess cavity. Even after the formation of an abscess the disease may subside, as is shown by the fact that sometimes at an ' interval ' operation one finds old caseated pus around the appendix. On the other hand, the abscess may increase slowly in size by insinuating its way between the adherent coils of intestine or by spreading backwards towards the loin. Eventually fluctuation may be detected, and such an abscess may attain to a large size containing half a pint, or even more, of pus, and may occupy a considerable portion of the abdominal cavity. It is important to remember that the abscess, after burrowing among the intestinal coils, may come to the surface in the left iliac fossa, and such cases, when seen for the first time, may be puzzling unless the history be studied carefully. (*b*) Failing the formation of limiting adhesions,

the presence of pus lying outside the appendix, free in the peritoneal cavity, will lead to a spreading suppurative peritonitis.

3. Perforation of the appendix may occur owing to a local patch of gangrene allowing the sudden escape of pus into the peritoneal cavity. This event is particularly apt to occur when the appendix contains a concretion. The presence of the concretion increases the destructive effect of the pent-up inflammatory products, so that complete destruction of the appendical walls occurs at the site of pressure. If the destruction of tissue has taken place slowly, and the resistance of the patient is good, protective adhesions may form and prevent the spread of the infective products. Failing the presence of adhesions, perforation will be followed by spreading suppurative peritonitis.

The clinical course in perforation is as follows: After the initial seizure there may be a slight remission of symptoms, or there may be a secondary rise of temperature and increase of local tenderness due to the inflammation spreading to the outer coats of the appendix. When perforation occurs there is often a sudden fall in the temperature and a cessation of the local pain and tenderness, and the abdomen may be soft and non-resistant all over. Such a sequence of events must be regarded with suspicion, as it is often an indication of the onset of spreading peritonitis; the pulse rate increases in frequency, the temperature rises again after the fall, the abdomen slowly becomes distended, and finally blown out and rigid, the patient's face becomes pinched and sunken, and vomiting becomes frequent, signs that suppurative peritonitis is present. We cannot insist too often that these are the *late signs* of suppurative peritonitis, and are evidence that surgical treatment has already been delayed too long. The time for the treatment of peritonitis is before it is present, and not after it has the patient in its grip!

When the appendix is retro-caecal or is located in a peritoneal pouch the abdominal tenderness may be very slight. In these cases the temperature, instead of falling gradually, remains persistently high, and unless surgical treatment be adopted the disease runs an unfavourable course. The infection is apt to spread up behind the peritoneum and set up a sub-phrenic abscess.

Even when an attack of acute appendicitis apparently has subsided, the patient is not necessarily out of danger. Although the inflammation of the appendix has subsided, infection may in the meantime have spread by the lymphatics to the sub-phrenic space, and result in a sub-phrenic abscess, or by the blood-vessels of the portal system to the liver, and cause abscesses in the substance of the liver. Eight or nine years ago, before I made it a rule to operate as soon as possible in all cases of acute appendicitis, I had four patients under my care who recovered from the initial attack, but who, before the time for an interval-operation had arrived, showed sudden signs of septicaemia and died within a few days. In each case the temperature had been normal for from seven to fourteen days, then there was a sharp rise, and the patients rapidly became so ill that any operation was out of the question. At the post-mortem examinations, in two of the cases there were multiple abscesses in the liver, in the third portal pyaemia, and in the fourth a small subdiaphragmatic abscess.

Acute Appendicitis in Women.—A primary appendicitis may lead to secondary inflammation of the adnexa, or conversely a primary inflammation of the genitalia may produce a secondary appendicitis. This is not surprising when it is remembered that in 40 per cent of the cases the appendix hangs down over the pelvic brim and is in contact with, or in close relation to, the right appendages, and that the lymphatics of the right infundibulo-pelvic fold communicate at the ileo-caecal angle with the lymphatics draining the appendix. According to Oschner 30 per cent of all cases of perforative or gangrenous appendices in the female have a secondary involvement of the right ovary or right tube. Krönig says that a right-sided pyosalpinx in a young patient in whom there is neither clinical nor bacteriological evidence of tuberculosis or gonorrhoea is almost certainly due to a primary appendicitis.

Appendicitis in women may predispose to sterility owing to obstruction of the tubes, the result of inflammatory adhesions round the appendix.

Acute appendicitis in women has to be diagnosed from acute salpingitis, tubercle of the tube with exacerbations, ovarian cyst with a twisted pedicle, and extra-uterine gestation. The differential diagnosis between acute appendicitis and acute affections of the right appendages is not only often very difficult, but is of considerable importance, because in acute appendicitis the wise course is immediate operation, in acute salpingitis or in an acute flare-up in a tuberculous tube it is better to postpone operation until the temperature has subsided. A careful cross-examination as to the history and consideration of the physical signs will make a diagnosis possible in most instances, but even with the greatest care mistakes may be made. A useful clinical point is this—with pain of sudden onset in the right iliac fossa, if the initial seizure be accompanied by vomiting, the malady is probably appendicitis, if accompanied by metrostaxis it is probably of tubal origin. As a rule, acute salpingitis is due to a secondary infection, hence the vaginal and urethral orifices should be examined for evidence of gonorrhoea. When the diagnosis is uncertain, before the abdomen is opened, a bi-manual examination should be made under the anaesthetic. In this way definite evidence of tubal mischief may be discovered.

In ovarian cyst with a twisted pedicle the diagnosis is usually easy, except when the patient is very fat, or is so distended and tender that examination is difficult. In these cases a bi-manual examination under an anaesthetic will clear up the diagnosis by the discovery of the ovarian cyst.

Extra-Uterine Gestation.—The sudden onset of severe pain which accompanies rupture of a tubal gestation may simulate acute appendicitis. As a rule, the differential diagnosis is not difficult, inasmuch as the menstrual history, the uterine discharges, the previous occurrence of irregular colicky pains, the symptoms of early pregnancy, the anaemia, absence of rise of temperature, together with the absence of the regular sequence of appendicular symptoms, lead to a correct diagnosis.

The treatment of acute appendicitis in women does not call for separate discussion. The appendix should be removed as soon as the diagnosis is made. In all cases in which the diagnosis is doubtful the incision should be made in the middle line, as then it is much easier to deal with the tubes if they be affected.

In view of the frequency with which the appendix is implicated secondarily to pelvic disease, many authorities advocate the removal of the appendix whenever salpingectomy or abdominal hysterectomy for catarrhal or suppurative salpingitis is performed, no matter what is the state of the appendix, and no matter whether it show a microscopic lesion or not, whether it be close to the tube, or far off, and whether or not there have been clinical manifestations referable to the organ. The only exception to the removal of the appendix will be where such removal would sensibly increase the duration and gravity of the principal intervention (Murphy).

Appendicitis during Pregnancy.—Acute appendicitis is a serious complication of pregnancy, because in addition to the risk attending the appendical attack, there is the added danger of premature labour complicated by sepsis. The mother's life is endangered, and the risk of termination of pregnancy is very great. The danger to the mother's life is increased by the circumstance that acute appendicitis during pregnancy is often overlooked, as the symptoms are attributed to the conditions incidental to the pregnancy. According to Donohue 80 per cent of the cases occur within the first six months of pregnancy.

Some authorities (Marse, Webster) advise that induction of labour should precede appendicectomy. The advisability of this practice is very doubtful. The important point is in such cases to remove the appendix, and to do so quickly and with the utmost gentleness, and in late cases of circumscribed abscess, to be content with a small incision and drainage, with no attempt to remove the appendix. In a fair proportion of the cases, the pregnancy will continue without interruption.

The patient should be kept in bed for several weeks longer than in an uncomplicated case of appendicitis, for premature labour may come on a considerable time after operation. In one instance in which I operated on a pregnant woman with acute appendicitis and diffuse peritonitis, premature labour came on twenty-seven days later. The patient recovered.

Acute Appendicitis in Children.—In children there are usually premonitory symptoms before the onset of acute appendicitis. In some cases it is noticed that the child's appetite has been poor, in others she has had signs of gastro-intestinal irritation. Not infrequently, for some days before the commencement of the attack there is pain on micturition, or a frequent desire to pass water.

As in other febrile disorders in children, the attack may be ushered in by a rigor or by a convulsion. As a rule the general symptoms are more pronounced, and the local signs less marked than is the case in adults. From the outset the temperature is high and the pulse rate much increased, and the rapidity of the breathing may suggest thoracic trouble. At first the pain may be obviously severe, but after a few days it abates markedly or disappears entirely, so that when the child is first seen there may be such complete absence of pain that the diagnosis is not easy. To add to one's difficulties it is often impossible to ascertain whether there is local tenderness or not, as the child resents pressure anywhere in the abdomen. Sometimes the pain is referred to the pelvis, and examination of the rectum may reveal great tenderness on the right side. In many cases there is a singular absence of local rigidity.

It is often stated that acute appendicitis runs a milder course in children than in adults, and that the inflamed appendix is more likely to be shut off by adhesions. This is contrary to my experience. My belief is, that in children acute appendicitis runs a more rapid course, and that general peritonitis is a more likely complication than in adults. Thus, although the local symptoms subside, the temperature remains high, the child's condition changes speedily for the worse, the face becomes pinched, and the expression careworn, the abdomen gradually becomes distended and blown up, vomiting begins, the temperature falls, the extremities become cold, the lips blue, and within two or three days the child is moribund. I do not maintain that this is the invariable course of acute appendicitis in children not treated surgically; undoubtedly some recover, but I am convinced that the proportion of children who recover without operation is much smaller than is the case in adults. In a series of cases of appendicitis in children collected by Kirmisson and Guimbellot, there were 9 cases in which the patients were under one year old, and all died. Of 26 below the ages of one and two years, 7 recovered. All the 7 patients who recovered were operated on, while none of the patients who died had received surgical treatment.

The Diagnosis of Acute Appendicitis.—It is only in a very small minority of cases that the diagnosis of acute appendicitis presents difficulty. The character of the symptoms and the order of their occurrence form a clinical picture which, in the majority of instances, cannot be mistaken. First, there is the sudden onset of acute abdominal pain, which for a few hours may be referred to the epigastrium, but later on almost invariably becomes localized in the appendical region. Secondly, there is a feeling of nausea, often followed by vomiting. Thirdly, tenderness and rigidity over the right rectus in the region of the appendix. Fourthly, a rise of temperature, in some cases not higher than 99° or 100° F., in others 104° or even 105° F.

There are two classes of cases in which the diagnosis is often very difficult. First, cases in which there is no rise of temperature. Such cases are rare. Indeed, Dr. Murphy says that elevation of temperature is never absent in acute infective appendicitis in the early stage. I have, however, met with two instances in which there was no rise of temperature whatever.

A young man aged 24 was seized suddenly with abdominal pain. I saw him two days later, he had some tenderness over the appendix but no rigidity, his pulse rate was 82, respiration 18, and his temperature was normal, and Dr. Lovell was certain that from the start it had never been raised. At first I was inclined to doubt the diagnosis, but the patient looked ill, and as the pain continued I operated and found a very swollen, acutely inflamed appendix.

In a second class of case the diagnosis is difficult because, when the patient is seen by the surgeon, the symptoms and physical signs of appendicitis are but slightly marked, sometimes even absent. Some years ago the writer called attention to these cases in an article on "Appendicitis without Physical Signs."[1] The following is an illustrative case :

A young woman aged 19 was seized with general abdominal pain three days before admission into the hospital. The next day she vomited twice, but the pain was easier. On admission her temperature was 99·8° F., and the pulse rate 112, but she had no physical signs, not even tenderness in the right iliac fossa. Under the anaesthetic it was noticeable that there was a slight impairment of respiratory movements in the right iliac region. I found an acutely inflamed appendix, with a perforation, from which pus was escaping. There were no adhesions round the appendix, but fortunately the collection of pus was local and had not been disseminated.

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[1] *Lancet*, August 19, 1911.

In such cases as these the diagnosis must be uncertain, but it may be pointed out that absence of tenderness is exceptional and likely to occur only in cases in which the illness is of some days' duration. Physical signs are almost invariably present in the early stage of the disease, hence it may be said, that in cases of acute appendicitis in the initial stage the diagnosis rarely presents difficulties. In those cases without physical signs we must rely on the history, and if this points to appendicitis, we must act on probability.

The Differential Diagnosis of Acute Appendicitis.—Although by careful attention to the order and character of the symptoms the diagnosis of acute appendicitis is usually easy, there are a number of conditions in which the symptoms may resemble those of acute appendicitis. In all cases therefore it is imperative to take a careful history and to make a thorough examination in order, by a process of exclusion, to eliminate all possible sources of error.

1. *Acute Ptomaine Poisoning.*—In this condition the sudden onset of abdominal pain, often accompanied by vomiting, may suggest appendicitis. In ptomaine poisoning, however, the temperature is subnormal rather than raised, the abdominal pain is diffuse and extends especially along the course of the large bowel. It is sometimes stated that while gentle pressure causes pain, deep pressure gives relief. This is not correct. There is usually tenderness all over the abdomen, but especially in the colonic area. There may be protective spasm all over the abdomen, but it is not more marked in the region of the appendix.

From a perforated appendix with commencing peritonitis and a sub-normal temperature, acute ptomaine poisoning may be distinguished by the general appearance of the patient; she may be in considerable pain, but does not look extremely ill. The pulse is good in volume and its rate little, or not at all, increased, and there is no general distension of the small intestine. Diarrhoea is more likely than constipation. There may be a history of the patient having taken some food likely to cause ptomaine poisoning, but too much stress should not be attached to such a history, as patients always seek to account in some way for the attack, and often on insufficient grounds. In acute ptomaine poisoning there is no leucocytosis.

2. *Acute Enteritis.*—In acute enteritis the pain is diffuse, not localized to any part of the abdomen, and is colicky in character. Diarrhoea is usual, and there is much intestinal peristalsis. The temperature is only slightly raised. Thirst is a prominent symptom and the tongue is thickly coated.

3. *Perforation of a Gastric or Duodenal Ulcer.*—Occasionally perforation of a gastric or duodenal ulcer may be simulated by acute appendicitis, as in the following case:

A man aged 45 years was seized suddenly with severe pain in the epigastrium, accompanied by vomiting. When I saw him six hours later he was evidently suffering severe pain, and his abdomen was rigid all over, especially over the upper part of the right rectus. His respirations were shallow, his temperature 98·2° F., and pulse rate 68. He referred his pain to the epigastrium, and there was no special tenderness over the appendix-area. The symptoms suggested a perforated duodenal ulcer, but there was no previous history of indigestion, and the patient seemed able to move about too much to have a perforation. However, four hours later, the pain was worse, so I decided that exploration was imperative. A small incision was made, but no perforation of the stomach or duodenum was found. The patient recovered. Six months later he had a similar attack, but on this occasion there was distinct tenderness over the appendix-area, and operation disclosed an acutely inflamed appendix.

I have little doubt that on the first occasion he was suffering from an attack of acute appendicitis. In such a case a correct diagnosis is very difficult, if not impossible, but " experientia docet," and some years later I met with a similar case, and on finding no evidence of a perforated ulcer I explored the appendix-region, and found a recently perforated appendix. The point to remember is, that in acute appendicitis there may be severe pain, *localized to the epigastrium*, without a rise of temperature and without tenderness in the appendix-area. In such cases we have to decide whether the patient has an abdominal lesion, and whether surgical treatment is required. The suddenness of onset and the severity of the pain is the main indication for surgical intervention.

A more likely error is to mistake a perforated duodenal ulcer for acute appendicitis. As has been pointed out above, in acute appendicitis the initial pain is often referred to the epigastrium and later becomes localized in the right iliac fossa. In perforated duodenal ulcer the pain is referred to the epigastrium, and persists there, but the fluid which escapes from the perforation tends to track downwards along the outer side of the ascending colon to the right iliac fossa, so that after a few hours there may be a very definite tenderness in the appendix-area. The diagnostic points to be noted are : In duodenal ulcer there is usually a history of pain two or more hours after food. In appendicitis if there be a history of indigestion, the pain comes on immediately after or within a short period of taking food. In perforated duodenal ulcer the temperature is sub-normal or slightly raised. In acute appendicitis elevation of temperature is the rule. In perforated duodenal ulcer the pain is more intense, and tenderness and rigidity are more marked in the upper part of the right rectus than in the lower. A board-like rigidity, such as occurs in a case of perforation, does not occur in acute appendicitis. Sometimes we can detect an area of dulness in the right flank owing to the accumulation of duodenal contents to the outer side of the caecum and ascending colon. In doubtful cases I have found this sign of great value. Lastly, the vomit in a case of perforated duodenal ulcer usually contains bile. This is never the case in acute appendicitis, except as a late complication.

4. *Acute Pneumonia or Diaphragmatic Pleurisy.*—In diaphragmatic pleurisy the pain is frequently referred to the epigastrium, less frequently to the appendix-region. There is rigidity of the abdominal wall, and often considerable distension. The great increase in respiration rate as compared with the temperature will suggest thoracic disease. Physical examination of the chest (which should never be omitted) will usually confirm the diagnosis.

5. *Acute Salpingitis* (see Vol. I. p. 624).

6. *Renal Colic.*—Colic due to a stone in the renal pelvis or in the ureter may simulate acute appendicitis. The pain, especially when the calculus is in the ureter, is severe and often excruciating, and radiates to the groin and scrotum in men, to the vulva in women. Frequency of micturition is a prominent symptom, and blood is passed in the urine which, if it be not visible to the naked eye, can be detected on microscopic examination. The attack may subside very quickly. The temperature is subnormal. An X-ray examination should be made as a matter of routine.

The following case in which there were both a diseased appendix and a renal calculus is of interest, and illustrates the difficulty of diagnosis which may be met with :

> A young lady was sent to me with a note from her doctor stating that she had had two attacks of acute appendicitis. The history she gave did not suggest appendicitis, and examination of the urine revealed the presence of pus, and X-ray examination showed a calculus in the renal pelvis. The stone was removed. Two days after she had left the nursing home she was seized suddenly with severe abdominal pain and had a temperature of 102° F. It was then clear that she had acute appendicitis, a diagnosis confirmed by operation.

J. B. Murphy's ' fist percussion ' of the kidney is a useful sign to determine the presence or absence of an acute pathological condition within the kidney. As illustrated in Fig. 26 the patient is seated in an upright position on a stool, and is then instructed to bend forward as far as possible. With the patient in this position the examiner from behind places his left hand flat upon the back of the patient over the kidney of the one side or the other, care being taken to have the hand firmly upon the back. The clenched hand of the examiner is then brought down with considerable force upon the dorsum of the fixed hand (Fig. 27), and if an acute congestion, impaction, retention in the pelvis of the kidney, or urethral obstruction exists in that kidney, the patient will cry out with the pain of the blow.

7. *Dietls' Crisis.*—The sudden onset of abdominal pain accompanied by rise of temperature, nausea, and vomiting, and sometimes by a rigor, may suggest acute appendicitis; this, however, may be excluded by the absence of tenderness over the appendix, while the presence of a movable kidney which is always associated with Dietls' crisis, indicates the true cause of the symptoms.

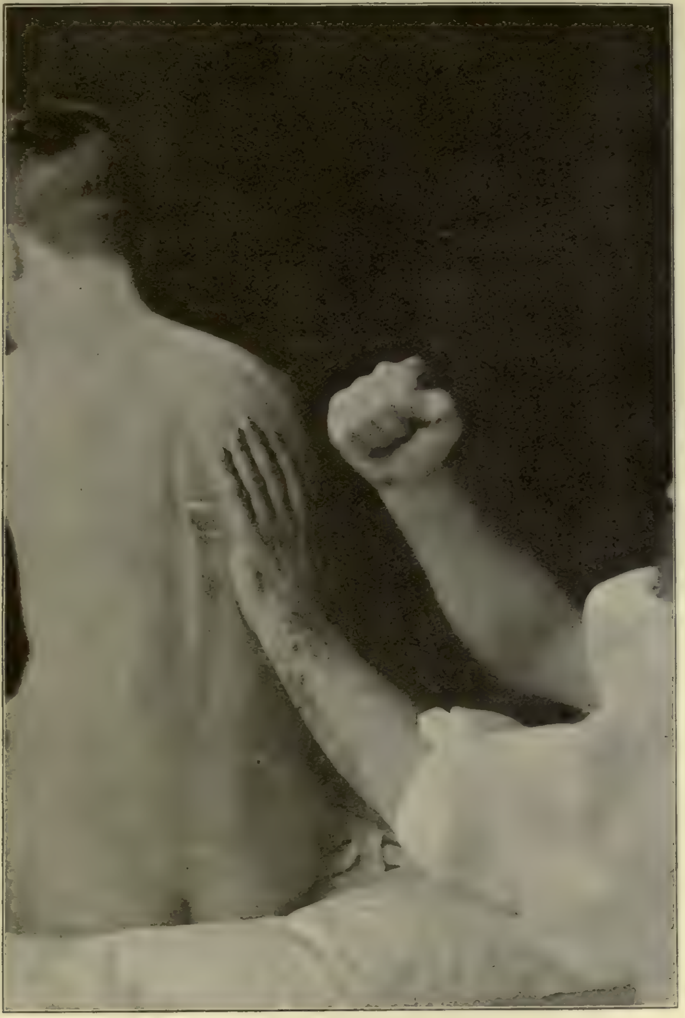

Fig. 26.—Fist percussion of the kidney. (Murphy.)

8. *Enteric Fever.*—When in the course of enteric fever an ulcer extends to the peritoneal coat of the bowel, or a perforation with localizing peritonitis occurs, there

may be sudden severe pain in the iliac fossa which suggests acute appendicitis. The important point of distinction between the two diseases is, that in acute appendicitis the pain precedes the rise in temperature whereas in enteric fever the rise in temperature precedes the pain. In enteric fever the general appearance of the patient, the tumidity and general softness of the abdomen, and the presence of an enlarged spleen suggest the nature of the disease. The diagnosis may be confirmed by Widal's test.

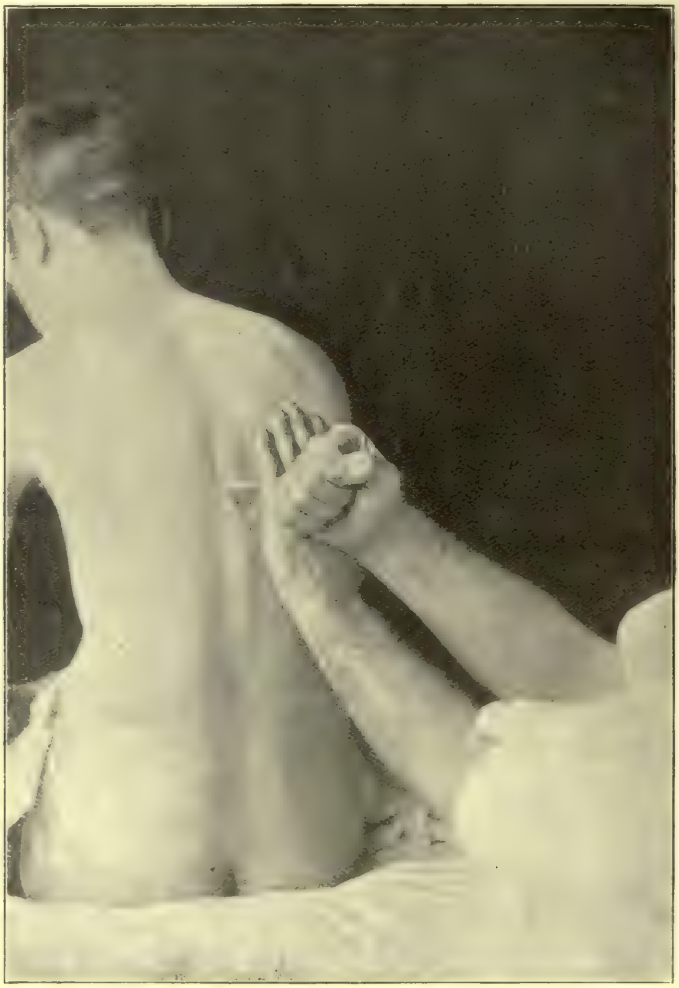

Fig. 27.—Fist percussion of the kidney. (Murphy.)

9. *Tuberculous Peritonitis.*—In children tuberculous peritonitis with an acute onset may at first sight resemble an attack of acute appendicitis, but usually the differentiation between the two conditions is not difficult. In tuberculous peritonitis the general enlargement of the abdomen, the flaccidity of the abdominal wall, the

prominent veins, the absence of marked tenderness in the iliac fossa, and the elevation of the temperature at night, with morning remission, form a clinical picture which makes the diagnosis clear. In addition there is often some free fluid in the peritoneal cavity as evidenced by dulness in the flanks which disappears when the patient is turned on one side.

10. *Intestinal Obstruction.*—In strangulation or obstruction of the bowel the sudden onset of pain, referred to the umbilicus, may at first resemble appendicitis, but there is no rise in temperature. Vomiting comes on early, is persistent and increases in frequency and in quantity. In acute appendicitis vomiting is not pronounced, and usually ceases after the initial seizure, and does not recur until the onset of peritonitis or mechanical obstruction. It is a mistake to suppose that abdominal distension is an early sign of intestinal obstruction. When the obstruction is in the small intestine there may be little or no distension even after twenty-four or forty-eight hours. The most significant symptom is the recurrence, at intervals, of colicky pains accompanied by peristaltic waves which can be felt through the abdominal wall, and later, when the abdomen has become distended, can be seen moving across the abdomen. This symptom is never present in acute appendicitis unless there be mechanical obstruction.

11. *Cholecystitis and Gall-Stone Colic.*—An acute attack of cholecystitis or of colic due to the presence of gall-stones may cause symptoms resembling those of acute appendicitis. In cholecystitis the point of maximum tenderness is under the right costal arch and not in the right iliac fossa. Not infrequently there is a history of some previous disease which may result in gall-bladder infection, such as enteric fever. In gall-stone colic there is no rise in temperature. The tendency of pain, due to gall-bladder trouble, to radiate to the right shoulder should be borne in mind. According to J. B. Murphy the most important differential sign of gall-bladder infection is an exquisite sensitiveness to perpendicular percussion and an inability of the patient to take deep inhalations with the finger hooked under the right costal arch. The method of carrying out these two tests is as follows : The examiner sits at the right side of the recumbent patient and presses the tip of the second finger of the left hand, flexed to a right angle, firmly up under the costal arch at the top of the ninth cartilage, as shown in Fig. 28. The patient is instructed to take a deep breath, and at the height of the inspiration, when the gall-bladder is forced below the costal guard, the flexed finger is struck forcibly with the ulnar side of the open right hand of the examiner (Fig. 29). If there be any inflammation or a retention in the bilary tract, the patient will announce that the blow caused him severe pain. Murphy calls this the ‘ hammer-stroke percussion.’

The other method called 'the deep grip palpation' is carried out as follows: The examiner stands behind the patient as shown in Fig. 30 (provided that the patient is well enough to assume an upright position, if not the examiner reaches over the recumbent patient from the head), and curls up his right hand under the costal arch at the top of the ninth cartilage. The patient is instructed to take a deep breath, and at the end of the expiration the examining fingers seek the gall-bladder area and fix it from beneath. The diaphragm descending from above with the beginning inspiration, brings down the liver and gall-bladder, and if a cholecystitis or cholithic obstruction is present, the descent is checked suddenly with an accompanying groan from the patient.

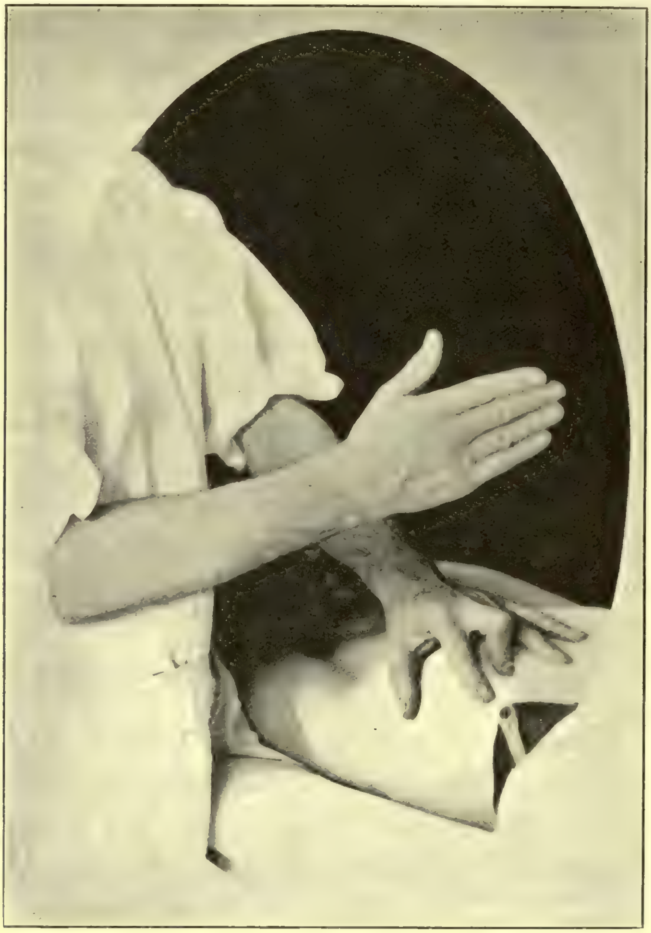

FIG. 28.—Hammer-stroke percussion. (Murphy.)

12. *Intussusception.*—In children intussusception in its early stages may be

mistaken for acute appendicitis. The sudden onset of pain accompanied by vomiting and tenderness in the right iliac fossa may suggest appendicitis, but there the resemblance ends. In intussusception there is no pyrexia at first, the abdominal walls are lax, there is no rigidity, and there is marked tenesmus, and after a few hours blood and mucus are passed *per anum*. In the early stage a swelling may be felt in the iliac fossa, at a period of the disease when, in appendicitis, no swelling would be felt; the swelling too is movable under the parietes and not fixed as in acute appendicitis. At a later stage the swelling may be felt in the left iliac fossa, and the apex of the intussusception may be detected on rectal examination. In cases of doubt a bi-manual examination should be made under an anaesthetic.

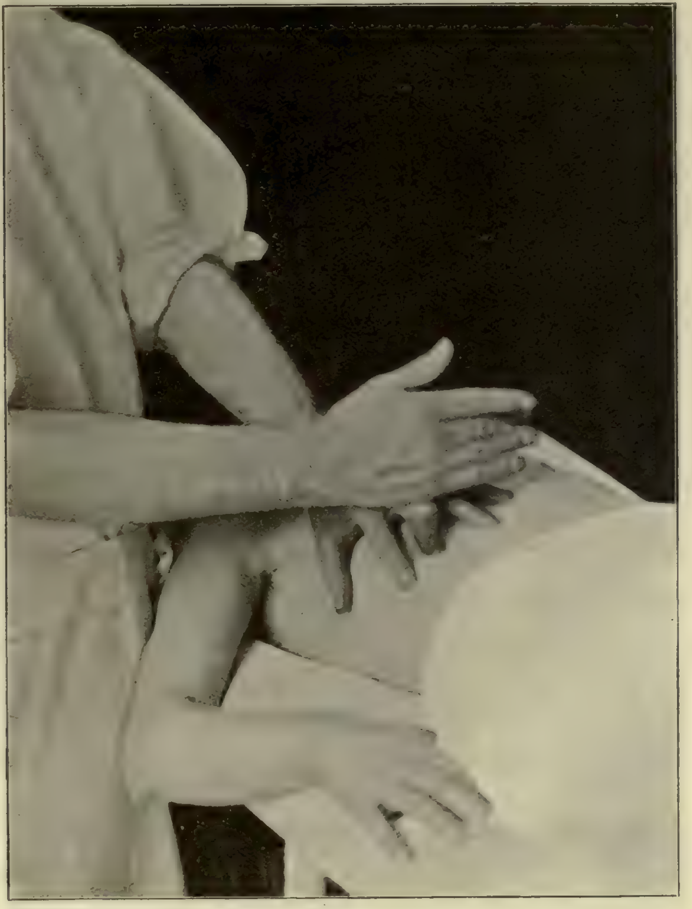

Fig. 29.—Hammer-stroke percussion. (Murphy.)

13. *Ovarian Cyst with Twisted Pedicle* (see Vol. II. p. 852).

14. *Extra-Uterine Gestation* (see Vol. I. p. 499).

15. *Thrombosis of Mesenteric Veins.*—The sudden and severe abdominal pain which accompanies the onset of this condition is apt to be mistaken for acute appendicitis. It may be admitted at once that a pre-operation diagnosis of mesenteric thrombosis is seldom made, and cannot be more than a mere guess. There are no pathognomonic signs or symptoms. The one symptom which might be suggestive is the rapid and pronounced toxaemia which almost invariably is associated with this lesion.

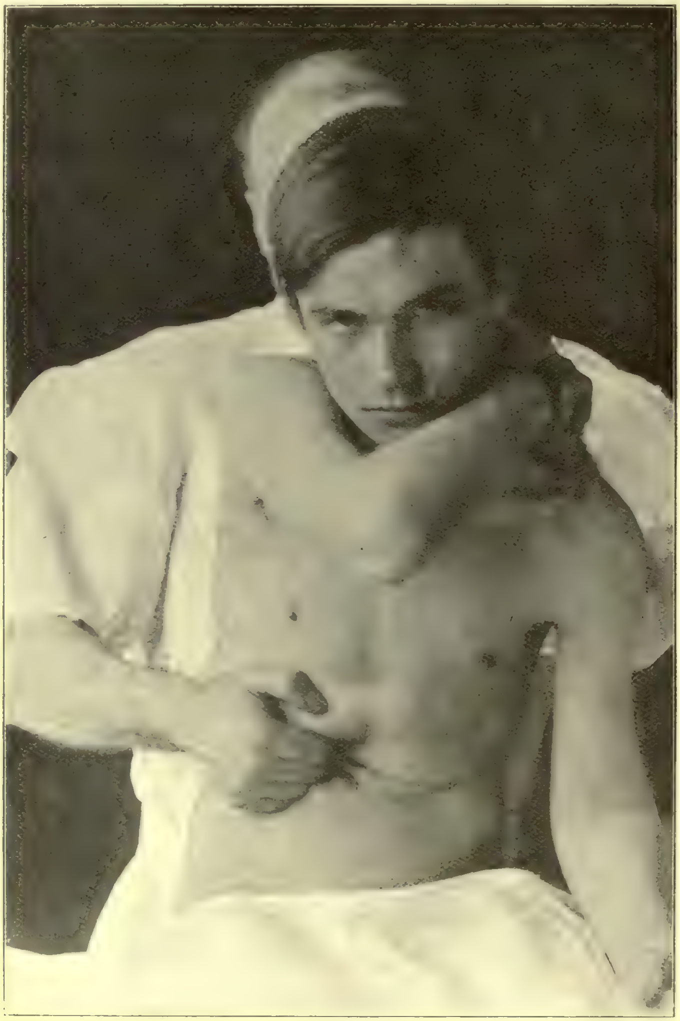

FIG. 30.—Deep grip palpation. (Murphy.)

16. *Acute Pancreatitis.*—Acute pancreatitis is not often diagnosed correctly, but it may be mistaken for acute appendicitis. In the haemorrhagic form the

temperature is subnormal at first, but may be slightly elevated later. In the suppurative form the temperature is raised from the onset of the disease. It is only in the very early stages that the two diseases can be confounded. The symptoms of acute pancreatitis are very acute, the course of the disease very rapid, and the condition of the patient changes for the worse very speedily. She becomes cyanosed, dyspnoeic, and extremely collapsed. The faeces contain an excess of fat.

The Treatment of Acute Appendicitis

The treatment of acute appendicitis is immediate operation as soon as the diagnosis has been made. Death from acute appendicitis is due to delay. As Dr. Murphy puts it so forcefully, "We should have no deaths from appendicitis, but *we are having them*."

In the past, there has been much discussion as to when to operate for appendicitis. By some the clinical course of appendicitis has been divided into stages, and operation is advised, or not advised, according to the day of the disease. These time-limits seem to me to be out of place in surgical practice. If it were the rule to operate early in all cases there would be no need to discuss the best time for operation. The time for operation is as soon after the onset of the disease as the diagnosis is clear, and this is usually within twenty-four hours or, at the most, thirty-six hours from the onset of the symptoms. If early operation were the rule the mortality would be well under 2 per cent. The risk of operation in the early stage is scarcely greater than that of an exploratory laparotomy. Usually no drainage is necessary, the patient is convalescent in from two to three weeks, there is little risk of ventral hernia, and the patient is freed from the liability to further attacks. This seems to me to be sound conservative surgery; the policy of procrastination has no claim to such a title. In this country Edmund Owen[1] has vigorously supported the policy of immediate operation. "The rule," he writes, "should be as definite and rigid as for strangulated hernia or cancer of the breast."

Those who oppose immediate operation do so on two grounds. First, that the majority of patients suffering from acute appendicitis recover without operation, and secondly, that so long as the inflammation is localized the risk to the patient is very slight, and so it is time enough to operate when perforation occurs. Let me deal with these two propositions at once. To assert that most patients recover without operation is beside the point. It is equally true that many die who might have been saved by operation. In a given case of acute appendicitis it is impossible to foretell whether recovery will ensue or not. The point to be emphasized is this:

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[1] *British Medical Journal*, February 15, 1913.

Frequently the local signs and general condition of the patient give no indication whatever of the gravity of the condition within the abdomen. Let me illustrate this with brief notes of four cases, the appendices from which are illustrated in Plate V.

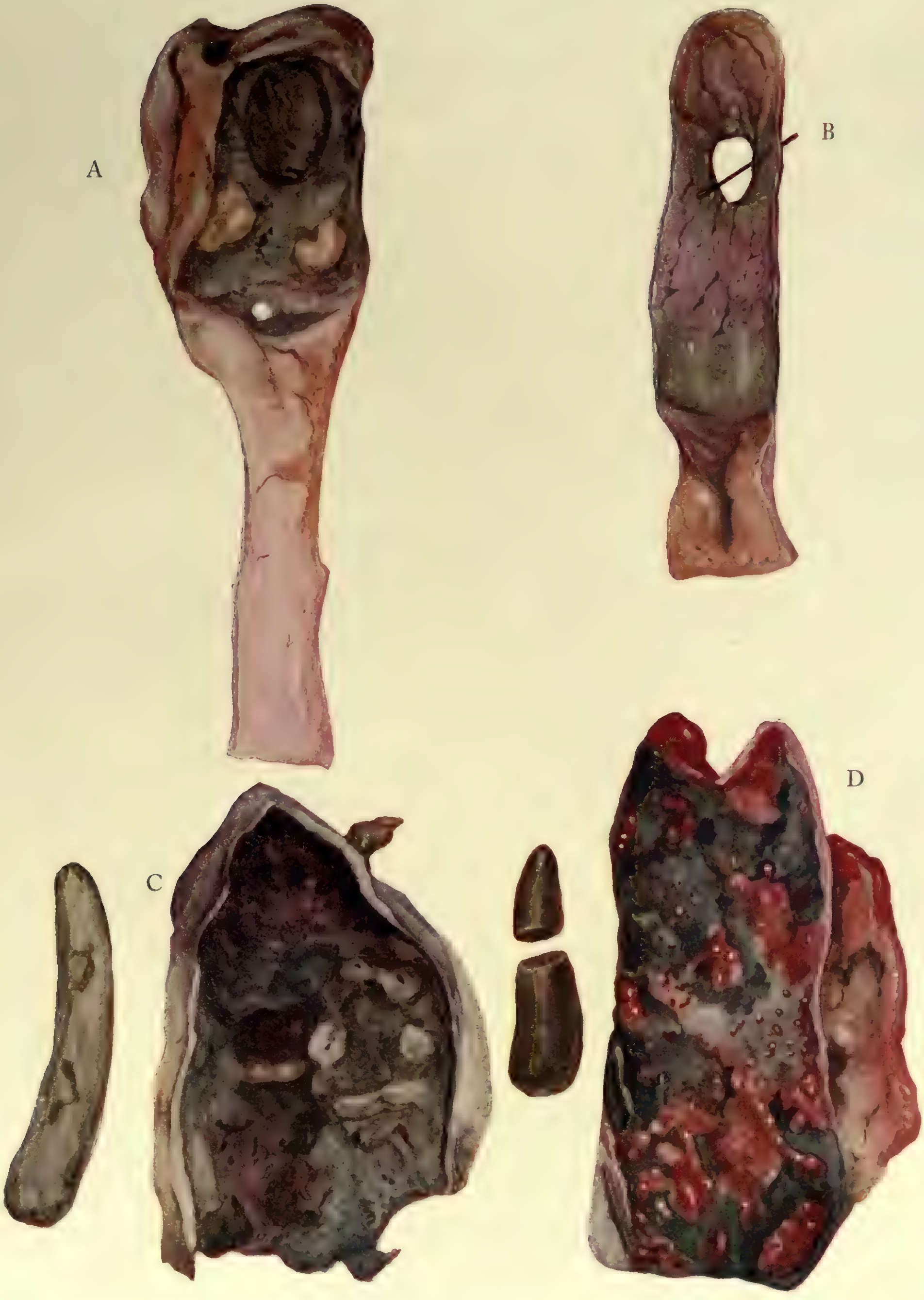
Case No. 1.—A young woman, aged 21 years, was seized with sudden pain all over the right side of the abdomen two days before admission. She had had no previous attacks. Gradually the pain decreased in severity, and on admission she stated that it had entirely gone. The pulse rate was 106 and the temperature 101° F., there was some rigidity and slight tenderness over the right rectus muscle. Two hours after admission the temperature was 99·4° F., and the pulse rate 100. The patient looked quite well, and it appeared to be a case in which the inflammation was quieting down. Following my rule, however, I decided to operate, and I found the appendix enormously distended (Plate V. Figure A) and the distal half completely gangrenous. There was a large concretion at the distal end, and a small perforation close to the gangrenous area. There were no adhesions. Uninterrupted recovery.

Case No. 2.—A gentleman, aged 31, was seized with sudden pain in the epigastrium and vomiting. The next day he was better and went to business. On the following day he again had sudden severe pain in the epigastrium. His temperature was normal, and his pulse rate 88. Later on his temperature was 102° F., and his pulse rate 108. I saw him in the afternoon, and his temperature had then fallen to 101·2° F., and his pulse rate had risen to 112. The patient did not look ill, and he had no pain. There was slight rigidity over both recti muscles, and there was very slight tenderness on deep pressure over appendix-region, some tenderness also in left iliac fossa. On opening the peritoneal cavity pus welled up from deep down behind the caecum. The appendix was much swollen, and there was a large perforation half an inch from its tip. Round the perforation the appendix was gangrenous, and near the base was a marked constriction. Just distal to this there was an ashy-grey area. The rest of the mucosa was acutely inflamed (see Plate V. Figure B).

Case No. 3.—A young woman, aged 25 years, was taken ill two days before admission to the hospital, with pain in the lower part of the abdomen. The next day she vomited twice, but the pain was easier. On admission she looked in fair health and was not in much pain. The temperature was 101·6° F., and the pulse rate 112. The abdomen was not distended or rigid, but there was tenderness in the right iliac fossa. On opening the abdomen I found the caecum enormously thickened and infiltrated, the appendix was greatly enlarged and distended, and was gangrenous at its base (see Plate V. Figure C), and, giving way, it allowed the escape of pus, faeces, and a large concretion. The end of the *caput coli* was gangrenous. There were no adhesions. Patient made a good recovery.

Case No. 4.—A lady, aged 59, was seized with sudden severe pain in the early morning, which woke her up. The pain became easier during the day, but became rather severe during the night. The following day the pain was easier, but her temperature was 101° F., and her pulse rate 88. There was slight tenderness but no rigidity over the right rectus. She was well nourished and did not look at all ill. The appendix was enormously enlarged,

PLATE V. Vol. III



Four appendices removed from patients suffering from acute appendicitis, in whom the symptoms were of a mild type, little suggesting the serious conditions revealed at operation. For description see text (p. 94).

TO FACE PAGE 94

perforated at one spot, and the meso-appendix (see Plate V. Figure D) was greatly infiltrated and thickened, and was very nearly as large as the appendix, and of a dirty ashy colour in places. The mucosa of the appendix was completely gangrenous in places, and of a dirty ashy-green colour, and the rest of the mucosa was intensely inflamed. The appendix contained a large concretion. Round the appendix there was about two ounces of very foetid pus. Good recovery.

Next, as to the teaching that operation should be delayed until perforation occurs. This teaching is based on the fallacy that perforation of the appendix gives rise to a characteristic train of symptoms. Although true hypothetically, this is a dangerous postulate in practice, for, by the time the symptoms are characteristic the opportunity for a successful operation probably has gone. The plain teaching of clinical observation in the light of the pathology of the operation theatre is this, that in any given case of acute appendicitis it is impossible to foretell what the subsequent course of the disease will be, whether it will tend to spontaneous subsidence or to a rapidly fatal termination. The time for operation is as soon as the diagnosis is made.

Many of those who are in favour of immediate operation in the cases which are seen early, that is, within the first twenty-four or forty-eight hours, counsel delay in those cases which are seen in the later stages of the spreading inflammatory process. They tell us that " each case must be judged on its own merits." This Is one of those high-sounding phrases which do not pass the test of practical application. In plain language this teaching premises that the clinician can picture to himself accurately the condition of the appendix, and can predict what will happen in the course of the next few days. All those who have had extensive operative experience of acute appendicitis know that such prescience is at present unattainable, and yet nothing short of it justifies procrastination when face to face with this disease.

Until such time as we can tell with greater precision what is the state of affairs within the abdomen, the safest and wisest course is immediate operation. There is, however, one exception ; when the patient is already profoundly toxaemic and the abdomen distended, it is sometimes wise to postpone operation for five or six hours, and in the interval to wash out the stomach and give several pints of saline *per rectum* and subcutaneously. In this way the condition of the patient may be improved temporarily to such an extent that even a desperate case may be tided through the operation successfully.

It must be admitted that the danger of operation during the later stages of appendicitis is increased, but I believe that the risks of the operation under modern conditions have been exaggerated. My reason for making this statement is the conviction that there is one very important consideration which has been overlooked in discussing the advisability of operation in these cases—namely, that owing to the introduction of the Fowler position and continuous proctoclysis by the Murphy method, the immediate mortality of operation in bad cases has been reduced enormously. The use of ether by the open method is another factor making for greater safety. Suffering as the patients usually are from toxaemia, the addition of such a toxic drug as chloroform is often just sufficient to turn the scale against recovery. The operation, however, *must* be limited both in time and extent. More often than not, these patients are suffering from profound toxaemia, and will not stand a prolonged or extensive operation. Excessive manipulations and handling of the intestines will increase the dose of toxins to a fatal degree. As Murphy puts it so well, " the extent of operation must be decided by the condition of the patient rather than by the extent or character of the pathological changes." It is true, without doubt, that the danger of operation in the later stages of the disease is greater than if done early, but the reply to objections to operation during this period is, first, that the danger of operation is less than the risk of further delay ; and secondly, that operation during the later stages should never be necessary, as it should be performed as soon as the diagnosis is made.

There is only one argument against early operation which requires consideration, and that is that an *early* diagnosis may be a *wrong* diagnosis. Undoubtedly this may happen, but when it does it is usually an error in diagnosis, not an error as regards the necessity for surgical treatment. Granted, however, that if we operate on every supposed case of appendicitis we may on very rare occasions perform an unnecessary operation, we must recognize that this is true also of other acute abdominal diseases, since in some instances symptoms may be present which simulate perforation or other serious condition so closely that one dare not postpone operation. In such cases, the risk of an unnecessary operation may be less than the risk of delay. It would be instructive if we could learn how many patients die owing to a delayed operation. Unfortunately, statistics to determine this question are not available ; but if the truth were made manifest, probably we should find that more patients are lost through delay than through precipitancy.

In acute appendicitis the symptoms are often so deceptive, the signs of danger so slight, and the ultimate issue so uncertain, that clinical observation, the living pathology of the disease, and the results obtained by the surgery of to-day, all point to early operation as the treatment of choice.

In a case of suspected appendicitis the patient should be kept in bed, in the semi-sitting position, and nothing should be given by the mouth except a limited amount of diluted milk with a cup of tea occasionally, if desired. The bowels may be opened by an enema, but on no account should any purgative be administered. This is a point which cannot be over-emphasized. There is no doubt that an immense amount of mischief is wrought by the injudicious administration of purgatives to patients suddenly seized with abdominal pain. It is too often the case that as soon as a child complains of abdominal pain the mother at once gives a dose of castor oil or other aperient, with the result that there is a sudden change for the worse, owing to the giving way of the newly formed plastic adhesions, or to perforation of the appendix. The use of purgatives in acute appendicitis is an interference with Nature's efforts to localize the inflammation by keeping the intestinal movements quiet and so favouring plastic adhesions. If it be necessary to move the patient to a hospital or nursing home for operation, she should be kept in the sitting position, as then, should perforation occur during the journey, the inflammatory products will tend to gravitate towards the pelvis away from the dangerous area under the diaphragm.

Preparation of the Patient for Operation.—Three-quarters of an hour before the time fixed for the operation a hypodermic injection of morphia gr. $\frac{1}{4}$ and atrophine sulph. gr. $\frac{1}{100}$ should be given. As before mentioned, ether should be the anaesthetic in preference to chloroform. Nitrous oxide gas and oxygen combined with infiltration of novocain (anoci-association) is better still, if the services of a skilled anaesthetist are available. In children and young adults who are profoundly toxaemic it is better to dispense with a general anaesthetic altogether and perform the operation with local anaesthesia only.

Preparation of the Operation-Area.—The skin of the *whole* abdomen is prepared in the following manner : The pubes is shaved and the abdomen well rubbed all over for five minutes with acetone and then swabbed with iodine paint. This paint is made up as follows :

Liq. iodi fort.	1 oz.
Spirit vini. rect.	2 oz.
Aq. destill.	1 oz.

Then the whole abdomen is covered with a dry sheet of sterilized gauze or lint, which is kept in place by a sterilized bandage. As soon as the patient is placed on the operating table the bandage is removed, and *before* the administration of the anaesthetic is commenced the whole abdomen is painted over again with the iodine paint.

In elderly and feeble patients and those who are already suffering from toxaemia it is a good plan to give a pint of saline *per rectum* an hour or two before the operation. As an additional precaution in such cases, while the patient is being anaesthetized, a needle may be inserted in each axilla, and a pint of saline solution run into each axilla from a rubber bag, after the method of Sir Arbuthnot Lane.

The Technique of Operation for Acute Appendicitis

The technique of operation depends to some extent on the stage of the disease. For purposes of description the operative technique may be described in four different stages of the disease.

(1) In the earlier stages, when the inflammation is limited to the appendix, before the formation of a circumscribed abscess or before the onset of diffuse peritonitis.

(2) In the stage of circumscribed abscess in the region of the appendix.

(3) When there is diffuse peritonitis.

(4) When there are localized abscesses in situations other than the appendix region.

1. **In the Early Stages.**—An incision two and a half inches long is made over the right rectus muscle one inch to the median side of the linea semilunaris. The incision is made so that it is bisected by a line drawn between the umbilicus and right anterior superior iliac spine. The anterior aponeurosis of the rectus muscle is divided along the length of the incision, the rectus muscle is displaced inwards and the peritoneum incised in the line of the skin-incision. The next step is to locate the appendix. This is best done in the following manner: the first two fingers of the left hand are inserted into the wound and passed downwards over the iliac vessels. The fingers are then drawn upwards until they encounter the terminal portion of the ileum, which is drawn up into the wound. By tracing the ileum to the caecum the base of the appendix is usually found quite readily. If lying free, the appendix is drawn up into the wound, or if there are adhesions these are separated gently with the finger-tip. The meso-appendix is clamped, and a needle threaded with No. 2 catgut is passed, *blunt end first*, through the meso-appendix close to its appendical margin, and tied in the groove made by the clamps. To obviate risk of slipping, it is a good plan to pass the ligature through the free edge of the meso-appendix. With a pair of scissors the meso-appendix is divided close to the appendix, right down to the *caput caeci*. A purse-string suture of fine linen thread is inserted around the base of the appendix at a distance from it of nearly half an inch. When the suture has been inserted half way round the appendix, a loop of thread is left for a purpose to be mentioned later. The appendix is then clamped a quarter of an inch from the caecum and a catgut ligature tied in the groove made by the clamp. The appendix is then cut across a little less than a quarter of an inch on the distal side of the ligature. The stump is touched with the actual cautery. The assistant

with the left hand holds the loop described above, and the operator holds the two ends of the purse-string suture; while the assistant with his right hand inverts the appendical stump and releases the loop of the suture, the operator ties the thread suture firmly, thus burying the stump of the appendix. The caecum is then returned within the abdomen.

At this stage of the operation the question arises : To drain or not to drain ? As a general rule in early cases drainage is unnecessary. If, however, the appendix has perforated, or if there is much infiltration of the meso-appendix, a drainage tube should be used. The indications for drainage require careful consideration. I think the way to regard the matter is this. Drainage does no harm, lack of drainage may prove disastrous. I quite admit that the peritoneum can deal with pus left inside, but when such cases are sewn up the wound almost invariably suppurates, and nothing is gained by non-drainage. If there is pus it is always advisable to drain the wound, and, therefore, it is safer to put the tube right inside. As our American friends say, it is better to take no chances, therefore a good working rule is—when in doubt, drain.

The wound is closed in the following manner : The peritoneum is sewn up with a continuous stitch of No. 2 iodized catgut, care being taken to evert the peritoneal edge. The suture includes the transversalis fascia, and is continued without interruption to the upper end of the wound where the needle is passed under the last loop and drawn taut. The needle is laid aside without cutting the catgut. A few silkworm-gut sutures are now passed through the remaining structures of the abdominal wall, namely through the skin, anterior sheath of the rectus on the outer side of the wound, and the anterior sheath of the rectus and skin on the inner side of the wound. These sutures are passed at intervals of an inch, so that in a wound four inches long three interrupted sutures would be employed. The ends of these sutures are secured temporarily with pressure forceps. The anterior sheath of the rectus is now sutured with the same needle and suture as was used for the peritoneum. The suture is continued from the upper angle of the wound to the lower, where it is tied to the end which was left long for the purpose when commencing the suturing ; the ends are then cut short. The skin-incision is closed by a subcuticular suture of silkworm-gut. The operation-area is painted over with iodine paint and covered with silver-leaf. A folded strip of gauze about an inch wide is laid lengthwise on the wound and the interrupted sutures are tied over it. This anchors the dressing, and at the same time prevents the discomfort caused by the sutures cutting into the skin.

2. The Stage of Circumscribed Abscess.—When there is a definite lump felt in the right iliac fossa, the incision should be made *not* over the lump but to the median side of it. There are two reasons for this procedure. First, the swelling felt through the abdominal wall may be an indurated caecum, with a drachm or so of pus deep down round the appendix, and if the incision be made over the swelling it may easily happen that the caecum might accidentally be opened. Secondly, if there be a localized abscess which has ruptured into the general peritoneal cavity, the accident will be recognized, and the necessary drainage instituted. If the swelling felt through the abdominal wall does not extend inwards beyond the outer border of the rectus, the incision may be made over the rectus muscle, as described above. If, however, the swelling is more extensive, the incision should be made in the middle line. In either case the peritoneal cavity is opened in the usual way, and the intestines are completely walled off with strips of gauze. Adhesions are then separated carefully so as to open the abscess cavity, and the pus is mopped out. If the appendix can be found readily it is removed in the manner described already. When the appendix is situated deeply and is much adherent, it may not be possible to bring it up into the wound without risk of damage to surrounding structures. In these cases it is simply clamped, ligatured, and the stump cauterized, no attempt being made to bury the stump by a purse-string suture. While it should be the rule to remove the appendix when operating for acute appendicitis, zeal must be tempered with discretion. The surgeon's aim is to get his patient well with the minimum of risk to life. Therefore, when the appendix is buried in dense adhesions, and especially in late cases of five to six days' duration, it is more often advisable to leave the appendix. Under these circumstances attempted removal may result in injury to the bowel or in serious haemorrhage which may prove fatal. Drainage is all that should or need be done. The appendix can be removed with safety at a later period. I always remove the appendix if I can, but in 10 per cent of the cases it is safer and wiser to leave it. Whether the appendix has been removed or not, a drainage tube is passed down to the abscess-cavity and secured by a stitch at the lower angle of the wound. If pus has overflowed into the peritoneal cavity a drainage tube is passed down over the iliac vessels into the pelvis, brought out at the lower angle of the wound and secured by a stitch.

In operating in cases of acute appendicitis in which there is a recent localized collection of pus, the surgeon should be on the look-out for secondary loculi connected with the main swelling. It is not rare to find a second collection of pus among adjacent coils of intestine, and if this collection be not discovered and drained it may extend and cause a fatal diffuse peritonitis. The abdominal wound is closed in the way described previously.

In those late cases in which there is a large, definitely fluctuating abscess, the treatment should be on ordinary surgical principles. An incision is made over the abscess and a drainage tube inserted, no attempt being made to find the appendix. If the abscess extend back to the loin, a counter opening may be made there and a drainage tube passed right through.

3. When there is diffuse Peritonitis.—In operating for diffuse peritonitis the cardinal principle to be observed is—a minimum of manipulation carried out in the minimum of time. The two indications are, to remove the source of infection and to institute drainage, and to do so as quickly as possible and with the utmost gentleness. As Dr. Murphy puts it, "Get in quick and get out quicker." The incision may be made either over the appendix (Battle incision) or in the middle line. Personally, I prefer the middle-line incision, as should the peritonitis be due to a cause other than appendicitis it can be dealt with more readily than through a lateral incision, and it is perfectly easy to remove the appendix through the median incision.

The abdomen having been opened, the appendix is located and removed by simple ligation and amputation. No attempt is made to wash or mop out the pus in the abdomen. Nature can deal with it better than the surgeon. A large rubber drainage tube is placed in the recto-vesical or recto-vaginal pouch, and a second tube is placed in the region of the appendix, and the wound sewn up in the usual way. The operation should not last more than fifteen minutes. During the operation saline should be run into both axillae.

4. When there are localized Abscesses in Situations other than the Appendix Region.—These should be treated on ordinary surgical principles and opened in the most convenient situation. A pelvic abscess in the female may sometimes be opened with advantage through the recto-vaginal pouch. If the abscess occupy the perinephritic region it may be drained through the loin. It should be remembered that sometimes an appendix-abscess may track across the pelvis and then come to the surface above Poupart's ligament on the left side of the abdomen.

Recurrent Appendicitis

Recurrent appendicitis is the term applied to those cases in which the patient, after recovery from an attack of acute appendicitis, has, on one or more occasions, a repetition of the attack.

Patients who have once had acute appendicitis and have recovered therefrom should be advised to have the appendix removed. Nowadays appendicectomy is so safe an operation that it is not worth while for the patient to run the risk of the danger incidental to a second acute attack.

It is sometimes taught that after a severe attack of acute appendicitis, especially if suppuration has ensued and has required drainage, usually the appendix is destroyed, and so operation is unnecessary. The correctness of this teaching is open to question. My experience is that the appendix is seldom, if ever, destroyed in the way suggested. At any rate, on one occasion only have I failed to find the appendix, even in patients who have suffered previously from very severe attacks. According to Makins, if acute appendicitis be treated by drainage without appendicectomy, a subsequent attack occurs in 39 per cent of the cases.

Appendicular Colic

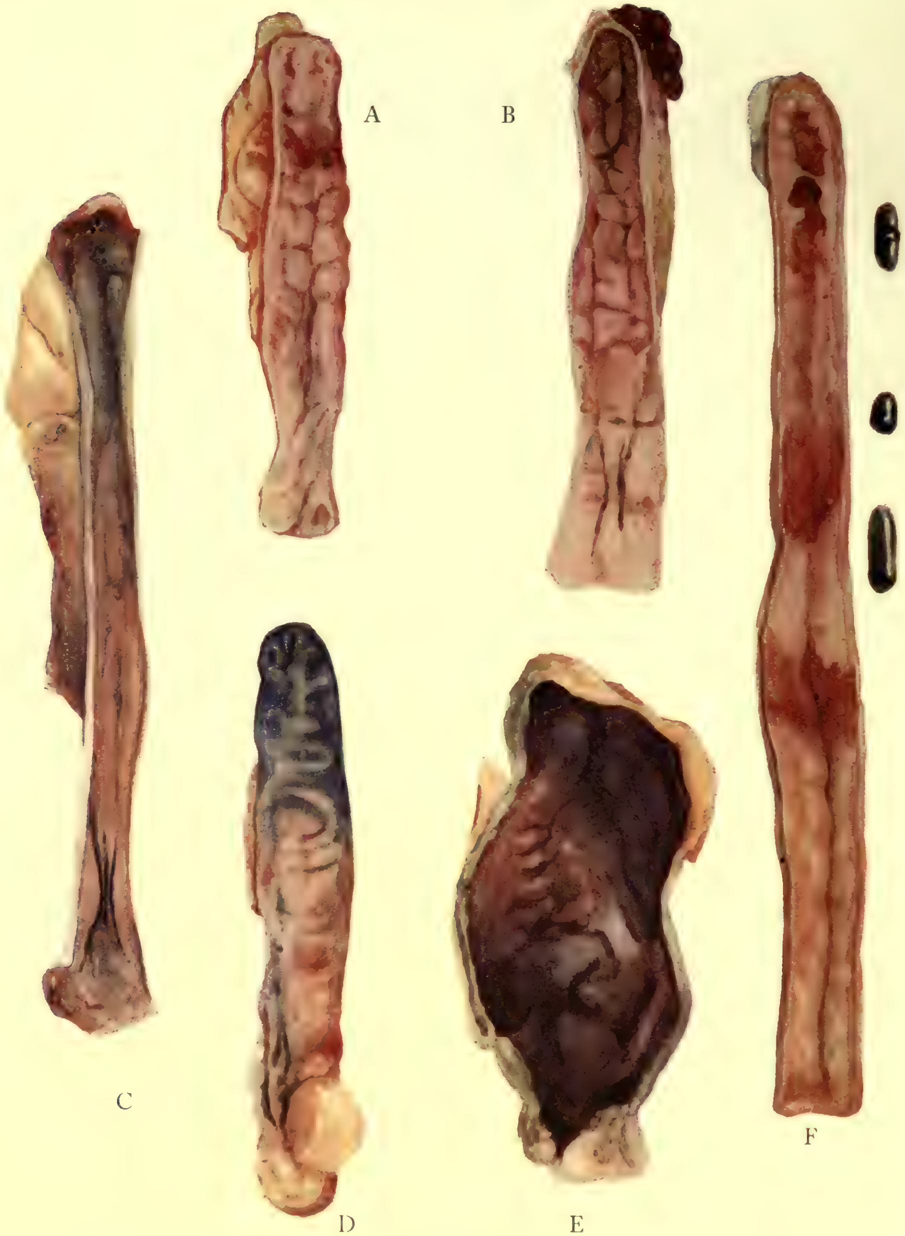
The term 'Appendicular Colic' is a convenient one to apply to those cases in which the patient has an attack of pain, in some instances of considerable severity, but not accompanied by any rise of temperature. As a rule local tenderness is absent, or at any rate slight, and there is no muscular rigidity. Such attacks may be recurrent, and when they are severe, or repeated so frequently as to cause inconvenience, the appendix should be removed. In operation for such cases it will be found generally that the appendix contains faeces or a faecal concretion. Probably the pain is due to violent contraction of the appendix spreading to the ileum and caecum, Nature's efforts to empty the appendical lumen.

Chronic Appendicitis

The appendix may be thickened and its lumen even completely obliterated without the patient ever having had an acute attack. This condition may be present without causing any symptoms, or it may give rise to a certain amount of discomfort in the appendix region, especially on exertion. In other cases the symptoms are mainly referred to the stomach, a condition for which I have suggested the term 'Appendicular Gastralgia,' and which Longuat described under the name of 'Appendicular Dyspepsia.'

Appendicular Gastralgia.—*Symptoms.*—Pain, varying in degree, is the prominent symptom in these cases. Some patients complain of what may be described as severe, continuous *discomfort* rather than pain, while some describe their *pain* as severe. In a large majority of the patients the pain follows the ingestion of food, although the interval between the taking of a meal and the onset of pain is very variable. Some patients state that the pain comes on immediately after taking food, while in about one-third of the cases the interval between taking food and the onset of pain varies from half an hour to three hours. In most cases the pain is referred to the epigastrium, usually to the right of the middle line. Some of my patients stated

PLATE VI. Vol. III



Sketches illustrating the condition of the appendix in cases of 'Appendicular Gastralgia.'

A. The mucosa is inflamed and rugous. There is a superficial abrasion of the mucous membrane near the tip, and a slight narrowing of the appendicular lumen near the base.

B. The inflammation and rugosity of the mucosa is more marked than in Figure A. Note the portion of inflamed omentum adherent to the outer surface of the appendix at its tip.

C. The mucosa is chronically inflamed, and the lumen of the appendix is dilated. Note the marked narrowing of the lumen near the base of the appendix.

D. The mucosa is the seat of marked chronic inflammation, and the distal portion is necrotic. At the base of the appendix is a mass of fibrous tissue which completely blocks the lumen.

E. The appendical lumen is enormously dilated and was filled with large putrid fæcal concretions.

F. The appendix measured 7½ inches in length. The whole of the mucosa is inflamed, and it is ulcerated near the tip. Within the lumen were three fæcal concretions.

None of the patients from whom these appendices were removed had had any symptoms referable to the appendix.

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that the pain radiated downwards to the right iliac fossa, while, with less definiteness, others said that the pain radiated downwards. In one interesting case the pain radiated to the left iliac fossa, and at the operation the caecum and appendix were found in the left iliac fossa. This radiation of the epigastric pain to the lower part of the abdomen is a most important diagnostic symptom, and in my experience is one which never occurs in gastric or duodenal ulcer.

Occasionally very definite 'hunger pain' is a symptom. Sour eructations and vomiting are present in considerably more than half of the cases. Flatulence and a feeling of distension after food is a very constant feature. Haemorrhage occurs as an occasional symptom (15 per cent of my cases), and I think that there can be little doubt that the haemorrhage comes from the gastric mucous membrane. In one case in which I opened the stomach, the whole of the mucosa was studded with numberless bleeding points. The interior of the stomach was in the condition described as 'weeping blood.' Probably this condition of the mucosa is due to the irritation of hyperacid gastric juice, or to the continual presence of gastric juice in the fasting stomach (hypersecretion).

Periodical Exacerbations.—A notable feature of these cases is that in many instances (67 per cent) there is a periodical exacerbation of the symptoms. As a rule the patients are not quite well during the interval between the attacks, but suffer from discomfort and flatulence after food.

Another striking feature is the long history in a large number of the cases. The average duration of illness in my cases is six years, although in one or two of them there was an interval of one or two years between the attacks. Tenderness in the epigastrium, usually to the right of the middle line, is an almost constant feature. In one-third of the cases there was tenderness over the appendix-area as well as in the epigastrium. By far the larger majority of the patients are women.

The Operation-Findings.—As regards the condition of the appendix, as a rule, judged by its external appearance, it is not extensively diseased. The most common condition is that the appendix is bulbous, somewhat thicker than usual ; and, on opening it, a narrowing or constriction is found near the base (see Plate VI. Figure A), the distal side of the constriction being slightly dilated and giving rise to the bulbous appearance. A concretion was found in exactly half my cases (Plate VI. Figures E and F). In all of my cases microscopic examination of the appendix showed the existence of chronic inflammation.

In some of the cases the disease of the appendix is more extensive than that described above. There may be minute haemorrhages in the mucous membrane, or a definite ulcerated area of the mucosa. In one of my cases the appendix was enormously dilated, measuring 3½ inches in circumference, the mucous membrane was ulcerated, and there were three large, very foul-smelling concretions in the lumen, as well as some blood-clot. The patient had had haematemesis as well as melaena.

There can be no doubt that an appendix, which on cursory examination appears to present no abnormal features, may be the seat of disease fraught with grave danger to its possessor. On a number of occasions I have removed an appendix which, by an onlooker, might be regarded as 'normal,' and yet, subsequently, I have been able to demonstrate to those present the existence of disease within. Such an appendix usually presents the following features: It may not be obviously larger than usual, but inspection shows that instead of being a uniform pale-yellowish colour its surface is covered with a branch-work of minute blood-vessels—evidence of chronic inflammation. By careful palpation one may detect that the appendicular coats are thicker than usual. On cutting open the appendix, usually it is found to contain faeces, or a concretion, the mucosa is congested, sometimes petechial or even definitely ulcerated. Microscopic examination shows the existence of chronic inflammation. However innocent-looking externally, an appendix which contains a concretion, or the mucosa of which is so damaged as to permit of bacterial invasion, is one which at any time may lead to a sudden attack of acute appendicitis.

The evidence that the gastric symptoms are due to the appendicular disease is threefold. First, the majority of the patients are cured by appendicectomy. The pain and discomfort are relieved, and the vomiting ceases. Secondly, there usually is an improvement in the character and quality of the gastric contents, which indicates the close physiological connection between the stomach and the appendix. Thirdly, the frequency with which patients who come under observation with an acute attack of appendicitis, give, on cross-examination, a previous history of gastric trouble, is certainly significant. A number of these patients state that for years they have suffered from what they describe as bilious attacks—that is, attacks of vomiting, with discomfort after food in the intervals between the attacks. More frequently the patients state that for a considerable time before the acute attack of appendicitis they have had to be careful as to their diet, otherwise they have suffered from indigestion. Soltau Fenwick has pointed out that before he recognized the connection between appendicular disease and gastric symptoms, he was acquainted with a peculiar type of hypersecretion in which frequently death occurred from appendicitis.

Differential Diagnosis.—The chief conditions from which appendicular gastralgia has to be distinguished are duodenal ulcer, gastric ulcer, and gall-stones.

(*a*) Of these, *duodenal ulcer* is the disease which gives rise to the greatest difficulty in differential diagnosis. The symptoms produced by duodenal ulcer, and by the cases of latent appendicitis to which I am referring, are very similar in many respects. There is often the same history of recurrent attacks ; both duodenal ulcer and appendicular disease may give rise to hyperchlorhydria, and also to entire absence of free HCl. Even ' hunger pain ' may be a symptom of appendicular disease. The points which aid us in distinguishing the two diseases appear to be :

First, in duodenal ulcer the patient usually is free from symptoms between the attacks ; in appendicular gastralgia, even between the attacks, the patient suffers from flatulence and discomfort after food.

Secondly, the radiation of the epigastric pain towards the lower part of the abdomen is highly suggestive, if not diagnostic, of appendicular trouble.

Thirdly, the existence of tenderness over the appendix sometimes throws light on an otherwise doubtful case.

Fourthly, in many cases of appendicular gastralgia the alteration of the gastric contents is not commensurate with the severity and duration of the symptoms. Let me explain what I mean by this. In a number of the cases which I have examined the gastric contents have been little altered chemically. This is not often the case in duodenal ulcer. In my experience duodenal ulcer most commonly produces, or is associated with, hyperchlorhydria, at any rate in the early stages ; later, occasionally, there is absence of free HCl. Appendicular disease apparently may exist for a considerable time without a marked alteration of the amount of free HCl. The combination of marked symptoms of duodenal or gastric ulcer, with a negative gastric analysis, is suggestive of chronic appendicular disease. The cases of appendicular gastralgia associated with hyperchlorhydria present the greatest difficulty in diagnosis. My impression is that hyperchlorhydria secondary to appendicular disease does not give rise to the severe pain which usually is associated with the hyperchlorhydria which accompanies duodenal ulcer.

Fifthly, a point on which too much stress should not be laid is, that duodenal ulcer is far more common in men ; appendicular gastralgia appears to be more common in women.

(*b*) In *gastric ulcer*, food, especially milk, often gives relief for the time being, the pain recurring one or two hours later. In appendicular gastralgia the onset of pain is more variable ; food, even milk, usually produces pain or discomfort at once. In gastric ulcer usually the motility of the stomach is not impaired, unless the ulcer be near the pylorus, in which case often there is food retention. In gastric and duodenal ulcer the pain is rarely so severe and continuous that the patient has to take to bed. In several of my cases of appendicular gastralgia, the patients have had to lie up on account of the continuous and exhausting character of the pain. Another point which is helpful in the diagnosis is this : the administration of bismuth and alkalis, in my experience, has little or no influence on the pain and discomfort due to appendicular disease.

(*c*) In *gall-stones* the pain has no relation to food, appears suddenly without any warning, and disappears as suddenly as it comes. It is not relieved by food or alkalis. Vomiting gives no relief. The pain may be exceedingly severe (biliary colic), and cause spasm of the diaphragm. The pain is epigastric and radiates to the back and right scapula, or may surround the right half of the chest like a girdle.

Cholelithiasis, in my experience, is never accompanied by hyperchlorhydria ; any change in the gastric contents is in the direction of diminished, rather than of increased free, hydrochloric acid, evidence of a secondary gastritis.

Vomiting is common in cholelithiasis but, unlike the vomiting in duodenal ulcer, is not followed by any abatement of the pain. In the early stage of gall-stone cases often there occur mild dyspeptic attacks, that is, irregular attacks of slight discomfort after food, accompanied by flatulence, sometimes coming on after food, sometimes not, appearing suddenly, disappearing as suddenly as they come. The irregularity of the onsets of these attacks, the absence of any constant relation to the ingestion of food, render these attacks very suggestive. In such cases gastric analysis will reveal little or no deviation from the normal.

How are the Gastric Symptoms produced ?—When we attempt to explain why appendicular disease should produce gastric symptoms, we are entering into the region of speculation. There is no doubt as to the close connection between the appendix and the stomach, but as to the exact nature of this connection I am not prepared to dogmatize. W. J. Mayo thinks that appendicular disease causes a protective spasm of the pylorus. Possibly this is the explanation of those cases in which there is hyperchlorhydria. As Fenwick has pointed out, the symptoms are those of hypersecretion. Exactly how the hypersecretion is caused we are not in a position to say. All we know at present is that in some way the appendix does affect the gastric secretion. Personally, I think that intestinal stasis, rather than pyloric spasm, is the condition in these cases. The symptoms may be regarded as toxic, the result of intestinal stasis. This view seems to be supported by the frequency with which the duodenum is found markedly dilated at operation, and by the fact that in a number of cases the stomach also is dilated. Further, as a rule, the quantity of gastric contents evacuated after a test meal is greater than in healthy individuals, the percentage of volatile acids is increased, and, in addition, flatulence and constipation are prominent symptoms.

The Indications for Operation.—That latent appendicular disease gives rise to gastric symptoms is now established definitely. The symptoms are those of hypersecretion or the so-called ‘ acid dyspepsia.’ I need hardly state that I do not suggest that all or even a majority of the cases of acid dyspepsia require operation unless the symptoms are persistent or recurrent. Persistent acid dyspepsia, in my opinion, is secondary to some definite organic lesion. When we have reason to believe that gastric symptoms are due to appendicular disease, then usually operation is advisable, provided that medical treatment has had a thorough trial and has failed. I hold it, as a cardinal principle, that in all cases of gastric disorders, except when there is evidence of some gross lesion, such as carcinoma, pyloric stenosis, or hour-glass stomach, it must be premised that medical treatment has been tried and has failed. And when I speak of medical treatment I mean, not a few weeks of drug-taking, but a course of rest and careful dieting extended over at least six months. It is the cases in which there are no physical or chemical signs which require careful consideration. In those cases in which, in addition to the gastric symptoms, there is definite and persistent tenderness over the appendix, operation usually is advisable. I confess I have an old-fashioned prejudice against operating when pain is the only symptom. At the same time, I recognize that there are such cases in which operation is not only justifiable but necessary. I take it that all are agreed that it is right to operate in cases of so-called ‘ appendicular colic,’ when such attacks are recurrent. Surely it is equally justifiable to remove the appendix when the patient suffers from recurrent attacks of gastralgia attributable to disease of the appendix, provided medical treatment has been tried and has failed. And in this connection I would point out again the diagnostic significance of radiation of pain to the lower part of the abdomen. I would insist, however, that the pain must be definite, and such that it interferes seriously with the patient’s enjoyment of life.

The Technique of Operation for Recurrent Appendicitis, Chronic Appendicitis, and Appendicular Gastralgia.—In operating for these conditions I prefer to make the incision in the middle line, and this for two reasons. First, a mid-line incision permits of exploration of the stomach and gall bladder, and of the pelvic organs in the female. There is always the possibility that symptoms attributed to chronic appendicular disease are due to gall-stones, to gastric or duodenal ulcer, or in women to disease of the tubes. It is not practicable to explore these viscera properly through a Battle or McBurney incision. Secondly, my impression is that one gets a sounder scar in the middle line. Unless the incision over the rectus is a very short one, a ventral hernia is apt to follow subsequently. If, therefore, one makes the incision over the rectus, and it is necessary to enlarge it considerably, the result may be a weak and bulging scar. In operation for acute appendicitis the conditions are rather different. Usually it is possible to do all that is required through quite a small Battle incision, and it is rarely necessary to enlarge it for the purpose of exploring other parts of the abdomen. A mid-line incision gives good access to the appendix, and the incision can be enlarged as much as necessary in difficult cases. It is much easier and safer to work through a large middle incision than through a cramped lateral incision. The details of the operation are similar to those described under acute appendicitis. As a rule drainage is not required.

AFTER-TREATMENT

The surgeon's duty does not end with the operation. Attention to detail in the treatment of patients after operation is second only in importance to the skilful performance of the operation itself.

Position.—Immediately after the operation the patient should be propped up in the sitting position (Fowler's position) by means of a large wedge-shaped pillow and two or three pillows. The best arrangement for preventing a patient from slipping down in bed is the following: An ordinary broomstick cut down to correspond with the width of the bed, is passed through a stout bolster, about nine inches in diameter, from end to end. The bolster is placed under the patient's thighs. To each side of the head of the bed is attached a stout leather strap. Each strap is attached by a buckle to another strap which has a galvanized iron ring fixed at its end. Each ring is slipped on at the end of the broomstick, and so prevents the bolster from being pushed down by the patient's weight. The position of the bolster can be altered by the buckle connecting the two straps.

Continuous Proctoclysis.—Immediately the patient is put back to bed the injection of saline by the rectum is begun. The largest size rubber rectal tube should be used, with a hole at the end and two holes at the side. The tube should be passed about three inches into the rectum, and should be kept in place by a piece of strapping passed round the thigh, or one of Murphy's self-retaining tips may be used. The rectal tube is connected by means of two feet of large rubber tubing with a douche can containing from four to five pints of saline solution, which is kept at a temperature of 125° F. The douche can is raised from four to eight inches above the level of the bed, so that the fluid runs slowly into the rectum at the rate of a pint an hour. After one and a half pints have been given the flow should be stopped, but the rectal tube should not be removed, and the flow should be started again two hours from the time it was originally commenced. After some hours it may be necessary to diminish the rate of flow, or lengthen the interval between the administrations. In this way from ten to fourteen pints may be given in the course of twenty-four hours. The important points are: (1) to keep the temperature of the saline solution constant, and (2) to regulate the flow by gravity, and not by constricting the delivery tube. A feeling of discomfort on the part of the patient indicates that the flow is too rapid, and if the saline be not retained, generally it means either that the flow is too rapid or that the temperature is too high or too low. Murphy, to whom we are indebted for this valuable method, maintains that if saline be not retained it is because it is not given properly. While I am not prepared to deny that a few patients do not retain salines well, I have no doubt that the successful employment of continuous proctoclysis depends mainly on the skill and attention of the nurse. Some nurses are far more successful than others. After an abdominal operation every patient should have the undivided attention of a special nurse for the first thirty-six or forty-eight hours. In a properly managed hospital or nursing home this is arranged as a matter of routine.

The regulation of the temperature of the saline requires constant attention, and to get over this difficulty I have had an apparatus made which simplifies greatly the use of this method. The apparatus (Fig. 31, *a*) consists of an electro-plated douche can which holds about five pints. In the front of the can are a thermometer and a gauge glass, by the side of which the can is graduated in half-pints, so that the amount of saline entering the rectum can be estimated readily. The saline leaves the can through a delivery-tube with a ½-inch bore, to which is attached two feet of rubber tubing connected with a large rectal tube. Under the bottom of the can is an electric heater, which can be connected with any electric supply of suitable voltage by means of a flexible cord and wall-plug. The can is suspended on an adjustable

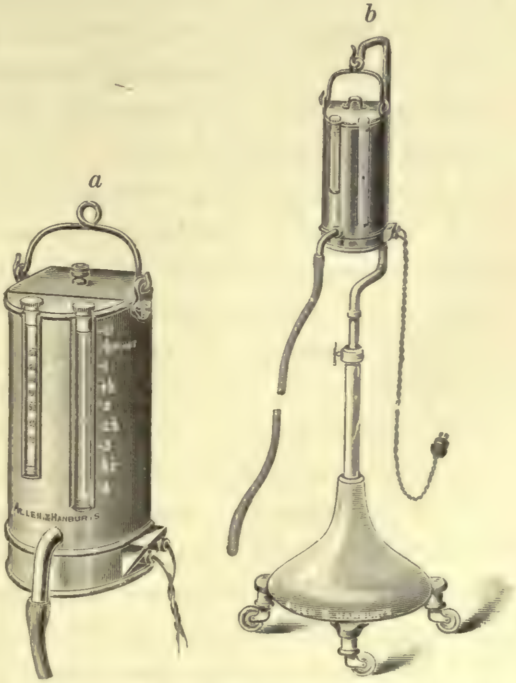

FIG. 31.—The author's electrically-heated saline apparatus.

stand mounted on castors, so that it can be readily wheeled up to the bedside (Fig. 31, *b*). I have found by experience that with a ward temperature of from 65° to 70° F. the solution in the can must be kept at a uniform temperature of 125° F., in order to ensure that the saline solution enters the rectum at a temperature of from 99° to 100° F. The electric heater is so made that if the saline solution be put into the can at a temperature of 125° F. the temperature remains almost constant so long as the current is switched on. Continuous proctoclysis acts in three ways: (1) It dilutes the toxins and renders them less harmful. (2) It stimulates the lymphatic flow and so drains the peritoneal cavity. (3) It raises the blood-pressure and so diminishes shock. Incidentally thirst is relieved. In cases of septic trouble it should be continued until the patient is out of danger.

Diet.—As soon as the patient desires a drink, small quantities of hot water are given, and if this be retained one-ounce doses of milk diluted with two parts of water are allowed. The quantity is increased up to two ounces hourly. I allow a cup of tea the same day as the operation, if the patient wishes it. On the day after operation Benger's food and calves' feet jelly are given as well as milk. As soon as the bowels have been opened the patient is allowed fluid *ad libitum*, eggs, thin bread and butter (no crusts), and other soft solids, and usually ordinary diet is resumed in a week or ten days.

In cases of general peritonitis, or in cases of perforation, nothing at all is given by the mouth until after the bowels have been opened. If vomiting continues after the operation, the stomach should be kept empty by gastric lavage, which must be repeated from time to time.

Rectal Feeding.—Rectal feeding is a scientific term for starvation. It is quite unnecessary after operations for appendicitis, because usually the patient, previous to the onset of the illness, has been in good health and can do without much nourishment until food may be administered by the mouth. In these patients it is fluid that is required rather than nourishment.

The Bowels.—I regard the early opening of the bowels as one of the most important points in the treatment of patients after operation for acute appendicitis. No hard-and-fast rule can be laid down as to how soon an aperient can be given. Each case must be dealt with according to the conditions present, and there is no detail of after-treatment in which sound judgment and experience are of such importance. The sooner the bowels are opened, the sooner the patient is out of danger. There is no better aperient than calomel given in half-grain doses every hour until the patient has had three or four grains. In an ordinary uncomplicated case an aperient is given on the third morning. In cases in which there is distension after operation the administration of calomel should be commenced on the second morning. After operation for septic peritonitis I often commence the administration of calomel on the same evening of the day of operation, in some cases as soon as the patient has come round from the anaesthetic.

The Treatment of the Wound.—I believe in a tight bandage for the first twelve hours; after this it may be loosened and readjusted. There is nothing so comfortable as a many-tailed bandage made of strips of domette seven inches wide and about seven feet long. The strips should be placed one inch apart, and should not be sewn together behind as is usual. It adds to the patient's comfort if the bandage be undone and rebandaged every day without disturbing the dressings. Every two or three days the bandage may be taken off and a fresh one put on. The old one can be washed and ironed ready for the next change. I have my wounds dressed and the anchor-sutures removed on the eighth day.

Drainage Tubes.—Occasionally drainage tubes are left in too long, but far more frequently they are removed too soon. This is especially the case after operations for general suppurative peritonitis, in which it has been necessary to place a drainage tube in Douglas' pouch. Such a tube should be kept *in situ* for at least a week, and sometimes for longer. If removed earlier it may be impossible to replace it, and as a result of too early removal, an abscess may form which may require another operation for the evacuation of the pus. As a general rule a drainage tube should not be removed until any discharge of pus has ceased for three or four days.

Duration of Rest in Bed.—As a rule the patient should remain in bed for three weeks after the operation. All patients should wear a firm binder or abdominal belt for six months after operation, and before discarding the belt they should have abdominal massage for two or three weeks.

Complications after Operation for Appendicitis

1. **Shock.**—The ideal treatment of shock is preventive. In my judgment by far the most potent means of preventing, or, at any rate, lessening shock is the use of morphia and ether instead of chloroform for the production and maintenance of anaesthesia. When ether is given by the open method it is rare for symptoms of shock to be marked, owing to the action of this combination of narcotics in blocking the afferent nerve-impulses. I do not say that shock is absent entirely, but that in the cases in which it occurs its onset is delayed until the effects of the ether and morphia are passing off, and at this stage it is easier to treat shock than during or just after the operation.

The first thing to bear in mind in the treatment of shock is that strychnine, brandy, and other so-called stimulants are useless, and indeed positively harmful. This has been shown conclusively by the work of G. W. Crile and others. Strychnine given to a healthy person raises the blood-pressure, but when administered to a person already suffering from shock, it causes a marked fall of blood-pressure, a result exactly opposite to that required in the treatment of shock. The best treatment for shock is the administration of continuous saline solution by the rectum, by the method described already. As regards drugs, adrenalin causes a marked rise in the blood-pressure. A drachm of adrenalin chloride (1 in 1000) may be added to each pint of saline solution. The objection to adrenalin is that its effect is very transient, so that to be of service the administration of the drug must be continued. Extract of pituitary body is a much more powerful agent, and its effects are more lasting. In an adult, an injection into the deltoid muscle of seventeen minims (1 c.c.) causes a marked rise in the blood-pressure, which lasts for eight or ten hours. It is, however, a powerful drug, and the dose must be regulated carefully according to the age and strength of the patient. The repeated application to the head of cloths wrung in very hot water is a valuable addition to the methods of treating shock which I have mentioned.

I never give intravenous injections of saline solution, as I believe that in some cases they do harm. If there be any difficulty with rectal administration, I prefer to let the saline solution run into the subcutaneous tissues of the breast and axilla. As I have mentioned already, I have all suppurative cases propped up in bed at once, whether shock be present or not.

2. **Pain.**—Pain is included among the complications of abdominal operation, because I believe that pain, as distinct from discomfort, is the exception rather than the rule. There is no doubt that patients vary very much in their susceptibility to pain, and in their capacity for bearing it. It is rare for hospital patients to complain much of pain after an abdominal operation; private patients on the other hand complain much more frequently of pain during the first twenty-four hours. I am very strongly averse from giving morphia after an abdominal operation; it relieves pain but it is harmful in other ways, and certainly adds to the patient's subsequent discomfort. We should try to ascertain the cause of the pain, and if possible treat such cause. Pain may be due to the patient's position, to undue tightness of the bandage, to excessive tightness of sutures, and in wounds above the umbilicus to the movements of the diaphragm. A frequent cause of pain, especially after the first twenty-four hours, is intestinal colic. This can be relieved at once by a turpentine enema, or a dose of calomel. In such a case morphia is the very worst mode of treatment. I confess that I dislike giving any drugs after

an abdominal operation, but if pain be so severe as to require treatment ten grains of aspirin repeated every six hours up to thirty grains, or a dose of trional, is the least harmful remedy. In neurasthenic patients the value of an hypodermic injection of sterile water should not be overlooked. Often it acts like a charm.

3. Septic Peritonitis.—When septic peritonitis is present at the time of the original operation, early opening of the bowels is indicated. In my experience when once the bowels are thoroughly well opened the patient may be regarded as out of danger.

The treatment of septic peritonitis originating *after* the operation is beset with difficulty. In by far the larger majority of the cases the safest course is to treat the patient by absolute rest, lavage of the stomach, and ice to the abdomen, in the hope that the peritonitis may be limited. If it be probable that leakage has occurred, the patient's only chance is a second operation to repair the leak, to cleanse the surrounding parts, and to establish drainage. Such operations rarely are successful. The patient's strength and nerve-cells have been exhausted already by one operation, and will be depleted still further by another. Therefore, before deciding to reopen the abdomen, the surgeon should have strong grounds for believing that a leakage has occurred. It is only under such circumstances that a second operation is justifiable.

4. Post-Anaesthetic Vomiting.—When ether by the open method in conjunction with morphia is the anaesthetic employed, post-anaesthetic vomiting is rare as a complication of abdominal operations. Since this anaesthetic has been the one usually adopted for my patients, I do not think that I have had to treat a single case of post-anaesthetic vomiting. If vomiting due to the anaesthetic persist, the best plan is to give a large drink of warm water containing twenty grains of bicarbonate of soda. If this fail the stomach may be washed out. Vomiting is certainly less common when the patient is propped up in the sitting position. Care should be taken that the head be turned to one side by placing a pillow under the opposite shoulder. The persistent vomiting which sometimes follows chloroform narcosis may be relieved in some instances by adding an ounce of glucose to the saline injection. In operations for intestinal obstruction often it is advisable to wash the stomach out before the anaesthetic is given, and in all such cases it is well to do so before the patient is put back to bed after the operation. In cases of vomiting from septic peritonitis, nothing should be given by the mouth, gastric lavage should be repeated at regular intervals, and the administration of calomel and eserine salicylate should be commenced at once in order to secure emptying of the intestinal canal as early as possible. When this has been accomplished usually the vomiting ceases.

5. Pseudo-Ileus.—Pseudo-ileus, or paralytic distension of the intestine, is most likely to occur in cases in which there is suppurative peritonitis, or in which there has been much handling, damage, or exposure of the intestines, or in cases in which it has been necessary to pack part of the abdominal cavity with gauze. If calomel be administered early, as I have advised, this complication will not occur often. When it does occur, the treatment is energetic administration of eserine salicylate, calomel, and turpentine enemata. I confess, however, that I am very sceptical as to the much vaunted efficacy of eserine salicylate. When gauze-packing has been employed the packing should be removed as early as possible. Strychnine is strongly recommended by some for the treatment of pseudo-ileus. In my experience it has proved quite valueless.

6. Lung Complications.—There is no doubt that the adoption of the Fowler position after abdominal operations has diminished greatly the frequency of lung complications. Formerly, pleurisy and empyema were not infrequent after operations for acute appendicitis. Since the routine use of the Fowler position I do not remember that I have met with either of these complications, except when there was already evidence of lung trouble previous to operation. Probably in some instances lung complications are due to slight local sepsis resulting in the detachment of a small septic embolus. In by far the greater number of cases I believe bronchitis and pneumonia following operation are due to deficient aeration of the bases of the lungs and to the accumulation of secretion in these situations. This hypostatic congestion is the result of the interference with the working of the diaphragm, partly from too tight bandaging, and partly from the involuntary inhibition of its movements caused by the wound.

It is no doubt a truth, based on the observations of many surgeons, that lung complications follow gastric operations more frequently than any others. And it is in stomach operations that the wound in the abdominal wall is situated nearest to the diaphragm.

I feel convinced that the occurrence of pneumonia and bronchitis in my practice has been diminished greatly by encouraging the patient to take deep breaths at regular intervals during the days following operation.

In the prevention of lung-complications I attach great importance to keeping the patient warm during the operation, both by means of clean warm clothing, and by the use of an operation table heated by electricity or other means.

The treatment of the bronchitis and pneumonia after abdominal operation presents no unusual features.

7. Subphrenic Abscess.—This is not a common complication of acute appendicitis. Dr. C. G. Ross met with it 31 times in 3891 cases of acute appendicitis (0·7 per cent). The cases may be divided into three groups: (1) Those in which a subphrenic infection is already existent at the time of operation. (2) Those in which the abscess forms shortly after operation. (3) Those in which the abscess forms at a much later period—after apparent convalescence. Most commonly a subphrenic abscess is due to direct extension of the infection upwards behind the caecum. In other cases it is due to the spread of infection by the lymphatics of the retroperitoneal cellular tissue. A subphrenic abscess may also form part of a general suppurative peritonitis. The infection of the lower abdomen clears up, but persists in the upper part with the formation of an abscess.

A subphrenic abscess may be anterior or posterior, and may be situated on the right side or on the left. When its origin is appendicular it is far commoner on the right side. The symptoms of subphrenic abscess may be very indefinite, the signs obscure, and consequently the diagnosis of some difficulty.

Symptoms and Diagnosis of Subphrenic Abscess.—The symptoms are those of septic absorption, daily rise of temperature, night sweats, occasional vomiting, and later, attacks of coughing accompanied by dyspnoea. As the abscess increases in size there may be physical signs of its presence, impaired movements and bulging of the lower part of the chest and displacement of the heart. The sudden rupture of the abscess into a hollow viscus or through the diaphragm into the pleural cavity, may be attended with severe collapse.

The Treatment of Subphrenic Abscess.—Subphrenic abscess is inevitably fatal, unless it be treated surgically. As a rule a subphrenic abscess is best opened and drained through the pleura after resection of one or more ribs. An incision about four inches long is made over the ninth rib on the right side, or over the seventh on the left side, and about three or four inches of rib resected. If the pleura do not contain fluid, the diaphragm and both layers of pleura are stitched to the chest wall. If the ribs be close together it may be necessary to resect portions of two ribs.

The edges of the wound are protected with gauze, and a director is pushed through the diaphragm into the abscess cavity. The opening is stretched with a pair of forceps and a large drainage tube inserted. It is not advisable to irrigate the abscess cavity either at the time of operation or subsequently. When a subphrenic abscess bulges in the epigastrium, or below the costal margin, it may be possible to open it by an incision in the epigastrium, or parallel with the costal margin. Sometimes a counter opening in the loin may be made with advantage.

8. **Parotitis.**—Parotitis may occur in cases in which food by the mouth is withheld. The treatment is preventive, careful attention to the cleansing of the mouth,

and frequent rinsings with listerine or hydrogen peroxide. In addition, the plan adopted by Soltau Fenwick is a good one. He gives the patient a baby's rubber teat to suck. The constant sucking induces a flow of saliva which helps to keep the mouth clean. The teat should be sterilized frequently by boiling. When parotitis occurs, fomentations should be applied, and if pus form it should be evacuated in the ordinary way.

9. **Phlebitis and Thrombosis.**—Phlebitis and thrombosis are less common after gastric than after pelvic operations. Thrombosis usually is secondary to phlebitis, but occasionally thrombosis is the primary condition. It is more likely to occur in feeble debilitated patients whose blood-current is sluggish. One of my patients died quite suddenly three days after an ovariotomy. At the *post-mortem* examination an *ante-mortem* clot was found in the pulmonary artery. Phlebitis is probably septic in origin, and is met with most frequently in the saphena and femoral veins of the left lower limb. It is rare for this complication to occur before the second or third week.

The treatment is absolute rest and elevation of the affected limb, and the period of confinement to bed should be increased to five or six weeks.

10. **Post-Operative Haematemesis.**—This is a rare complication of operation for appendicitis. When it occurs it is probably due to sepsis. Surgical intervention is contra-indicated. The treatment should be ice to the abdomen, gastric lavage, very hot saline by the rectum, abstinence from food by the mouth, and the administration of calomel.

11. **Faecal Fistula.**—Occasionally operation for appendicitis is followed by a faecal fistula. It may result from one of three causes: (1) Local gangrene of a portion of the caecum or terminal portion of the ileum. The infection may be so virulent that at the time of operation part of the caecum is already gangrenous, or the inflammatory process may continue after operation and lead subsequently to gangrene. (2) Leakage from the stump of the appendix. (3) Laceration of the bowel in separating adhesions.

The surgeon should never be in a hurry to operate on a faecal fistula following operation for appendicitis. The great majority close spontaneously without operative intervention. The patient should be allowed to recuperate thoroughly from illness before operation is considered. If the fistula be a small one it is sufficient to excise the fistulous track, free the bowel from the abdominal wall, and close the hole with a through-and-through continuous suture and a serous suture. It is a waste of time to attempt to close these fistulae without separating the bowel from the abdominal wall. The stitches invariably cut out. If the fistula be a large one owing to gangrene of a considerable area of the bowel, it may be necessary to divide the ileum across and anastomose it laterally to the ascending colon, and then resect the damaged portion of the caecum with the fistula. In all cases I think it is advisable to wait at least eight to ten weeks, or even longer, before operative measures are undertaken.

THE END-RESULTS OF OPERATION FOR APPENDICITIS

From time to time the statement is made that the remote results of the operation of appendicectomy are unsatisfactory. Undoubtedly it is the case that after operation for acute appendicitis some patients suffer subsequently from attacks similar to those which occurred previous to operation ; more particularly is it true that appendicectomy for chronic appendicitis is not invariably followed by relief. Nevertheless, the general statement that the remote results of appendicectomy are unsatisfactory is not borne out either by experience or by examination of the statistics compiled by those who have investigated this point. Drs. Scudder and Goodall [1] enquired into the after-condition of 640 patients some years after operation. In 4·4 per cent only of the cases was the result reported as poor, in the remaining 94·6 per cent the result was quite satisfactory.

The causes of failure must be considered (1) with reference to operation for acute appendicitis, (2) with reference to operation for chronic appendicitis.

(1) Failure after appendicectomy for acute appendicitis may be due to one or more of several causes.

(*a*) The operation may have been performed on a wrong diagnosis. The symptoms may have been due to intestinal, renal, or ureteral colic, or to acute salpingitis, or to some lesion elsewhere than in the appendix. In rare instances there may be some other lesion in addition to acute appendicitis.

(*b*) The appendix may not have been removed completely. There is no doubt that in some instances in which the appendix has not been removed flush with the caecum, the patients have had pain due to the stump of the appendix which has been left behind. Removal of the stump has resulted in permanent cure.

(*c*) *Post-Operative Adhesions.*—It is probable that the importance of adhesions as a cause of pain after appendicectomy has been exaggerated. Intestinal adhesions, except in so far as they may produce stasis or mechanical obstruction, do not appear to cause trouble, but adhesions between the intestine or omentum and the parietal peritoneum may cause very annoying and constant pain. Re-opening the abdomen and dividing the band between the parietal peritoneum and the caecum or omentum usually gives immediate relief.

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[1] *Publications of Massachusetts General Hospital*, January 1913.

(2) Failure after operation for chronic appendicitis occurs most often in cases of appendicular gastralgia. In at least 15 per cent of the cases appendicectomy fails to give relief. Such cases come under the following groups :

(*a*) Erroneous diagnosis. The symptoms may have been due not to the appendix but to some other lesion.

(*b*) Post-operative adhesions.

(*c*) The symptoms may be due to an ileal kink (Lane's kink) or to intestinal toxaemia from stasis. This is probably the commonest cause of persistence of symptoms after appendicectomy for appendicular gastralgia.

(*d*) J. S. Horsley [1] believes that the ileo-caecal fold is responsible in some cases for the persistence of symptoms after appendicectomy. The fold is attached to the terminal ileum opposite its mesentery and to the ileo-caecal junction, and passes down to join the meso-appendix and sometimes the appendix itself. Horsley advises that this fold be removed as well as the appendix, otherwise after the removal of the appendix the ileo-caecal fold may exert traction on the ileum and produce a kink.

The Appendix in relation to Intestinal Stasis

There is no doubt that the appendix plays an important rôle in the production of intestinal stasis. In some cases the appendix is bound down by adhesions in such a manner that it produces a definite obstruction of the ileum, and so prevents the free emptying of the ileal contents. In these cases removal of the appendix frees the ileum and relieves the patient. In other cases there are definite bands binding down or kinking the terminal portion of the ileum (Lane's kink). Whether these bands are of developmental (Lane) or of inflammatory origin is of academic interest. In my opinion, it is difficult to resist the conclusion that in the majority of cases they are of inflammatory origin, and are probably secondary to the inflammation of the appendix.

I believe that in many cases intestinal stasis is due to spasm of the appendix spreading to the terminal portion of the ileum. It is not without significance that frequently the appendix contains a concretion or some putrid faeces. I believe the spasm is due to Nature's effort to empty the appendix. While operating in such cases I have many times observed the appendix writhe vigorously when touched. That such a contraction may occur during life is suggested by the severe attacks of pain—the so-called appendicular colic—which may be caused by an appendix which has little wrong within it except that it harbours a concretion.

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[1] *Virginia Medical Semi-Monthly*, June 23, 1911.

THE OPERATION OF APPENDICOSTOMY

The operation of appendicostomy, that is, drawing the appendix through an aperture in the abdominal wall, and then cutting it across level with the skin and so using the lumen as a temporary or permanent opening into the caecum, by which irrigation of the large bowel may be carried out, has been advised in cases of intractable colitis. The results of this procedure are disappointing.

In my experience, however, the operation is a very valuable one as an adjunct to ileo-colostomy (Lane's operation) in cases of chronic intestinal stasis. The improvement in health and comfort resulting from an ileo-colostomy is very remarkable, but in a considerable proportion of the cases (in my experience 70 per cent), faeces regurgitate backwards up the descending colon and accumulate in the caecum and give rise to discomfort and distension. If, however, an appendicostomy be performed, the caecum and large bowel can be flushed out once or twice a week, and so kept free from faeces. This, in my judgment, seems a more advisable course than complete colectomy.

I have adopted this plan in ten cases, and the results have been excellent.

Appendicostomy is performed in the following manner: the appendix is sought for, and drawn out, through a stab incision through the abdominal wall just above the anterior-superior spine. The base of the appendix is fixed to the peritoneum by a couple of fine linen stitches. The appendix is cut across just above the level of the skin. The remaining portion of the appendix is split for about half an inch, and the edges of the appendix secured to the skin by a stitch on each side of the wound in the abdominal wall.

TUBERCULOSIS OF THE APPENDIX

Tuberculosis of the appendix is a rare disease. In one hundred operations for appendicitis, the appendix is the seat of tubercle in not more than one or two cases. The disease may be primary or secondary, and when secondary the primary focus is commonly in the adnexa.

The usual path by which the tubercle bacillus reaches the appendix is from the lumen of the caecum, and most frequently it infects the tip. The progress of the disease is slow, and perforation into the general peritoneal cavity is uncommon. A localized abscess may form, which is apt to perforate into the bowel, or may burrow along the psoas muscle or infiltrate the abdominal wall. When the inflammatory process spreads through the appendicular walls and affects the peritoneum, adhesions to neighbouring portions of bowel may result in the formation of a mass which may be felt through the abdominal wall.

Symptoms.—Tubercle of the appendix is rarely diagnosed before operation. There is nothing characteristic about the symptoms. Occasionally the onset is acute, but most often the disease resembles an ordinary case of chronic appendicitis.

Carcinoma of the Appendix

Primary carcinoma of the appendix is rare. According to McCarthy and McGrath, in 8039 appendices removed by operation at the Mayo Clinic, carcinoma was found in 40 (0·4 per cent). In five only of these cases was the lesion large enough to be recognized at the operation. In the majority of cases operation has been performed for chronic appendicitis. The growth is most often at the distal end (Fig. 32). Carcinoma of the appendix is remarkable in that it is of a far less malignant type than cancer of other parts of the intestine.

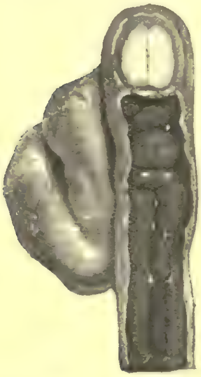

Fig. 32.—Carcinoma of top of appendix.

Sarcoma of the Appendix

Some fourteen cases of sarcoma of the appendix have been reported.[1] In two instances, reported by C. A. Powers and R. Wright, the patients were only seventeen years of age. In both cases the growth was a round-celled sarcoma. The condition is of great rarity. As a rule the disease is confined to the distal end of the appendix, does not invade the surrounding tissues, and does not give rise to metastases. In some instances the disease starts at the base and invades the caecum. In none of the recorded cases was the condition diagnosed until after a microscopical examination had been made.

Hydatids of the Appendix

An example of this disease has been recorded by Birch-Hirschfeld. The appendix contained a mass of semi-transparent vesicles of varying size. The connection between the appendix and the caecum was obliterated, and there was considerable atrophy of the walls of the appendix owing to the pressure of the cyst.

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[1] White and Whaland, *Med. Review*, May 23, 1914.

Intussusception of the Appendix

Moschcourtz [1] has reported 25 cases of this condition, including one of his own. He gives the clinical picture as follows: A child in the first decade of life, with a more or less protracted history of repeated attacks of severe abdominal cramps, occurring remittently with periods of well-being, who has a small palpable swelling in the right iliac fossa, and blood in minute or gross quantities in the passages, should be suspected of chronic intussusception of the appendix. A case in a boy aged eighteen has been reported by T. H. Watson.[2]

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[1] *Med. Record*, 1910, ii. 1088.

[2] *Lancet*, July 29, 1911.

METHODS OF EXAMINATION OF THE URETHRA AND BLADDER

By J. W. Thomson Walker, F.R.C.S.
(London)

A. The Urethra

The female urethra is 1½ inches in length, and is almost straight, having a slight anterior concavity. It is intimately united with the anterior wall of the vagina. The internal meatus is situated at a lower level than in the male, being on a level with the lower border of the pubic symphysis, and a little nearer to it (15 mm. instead of 20 mm. in the male).

There are two narrow parts of the urethra, the internal meatus and the external meatus, while the calibre of the intermediate portion is greater. Sounds of 10 or 12 mm. size pass easily. By forcible dilation the canal can be made to admit the forefinger; this, however, is frequently followed by incontinence of urine from laceration of the sphincter muscle.

The external meatus is a vertical slit immediately in front of the entrance of the vagina, and is the narrowest and least elastic portion of the canal. The edges of the external meatus are usually smooth and regular, but the mucous membrane surrounding the orifice may be thrown into irregular folds and tags. At the internal meatus the conformation of the tube is a transverse slit, in the intermediate portion it is star-shaped, and at the external meatus it is vertical. The mucous membrane is thrown into longitudinal folds, a specially prominent fold running along the posterior wall. Between the folds lie the orifices of numerous mucous glands. Immediately within the outer orifice are several large glands. The epithelium is stratified and squamous at the lower part of the tube, but in the neighbourhood of the internal meatus it becomes transitional. Beneath the mucous membrane are numerous elastic fibres and a plexus of veins, while the *compressor urethrae* muscle surrounds a part of the tube.

Examination of the urethra should be carried out with the patient in the dorsal position, with the knees flexed and widely separated. The feet are placed on rests at the level of the couch, or leg rests may be used supporting the concavity of the knees. The surgeon sits facing the perineum. On separating the labia minora the urethral meatus is seen immediately above the margin of the vaginal orifice. Occasionally a number of depressions are seen in this region, and the urethral orifice can only be found by probing each.

The *appearance of the lips of the meatus* should be noted. The posterior wall of the urethra may project a little, and form a red pouting lip, without any disease being present. Prolapse of the urethra occurs in young girls and in old women. In a slight degree it appears as a ring of pouting dark red mucous membrane in the position of the urethral orifice. A centrally placed depression represents the lumen of the urethra, and the prolapsed mucous membrane is thrown into prominent folds like a ring of piles. In severe grades the prolapse is reddish purple and mushroom-shaped, with patches of necrosis and ulceration. When urethritis is present the lips are red and puffy in appearance, and yellow discharge can be seen exuding from the orifice. Some of the urethral glands in the neighbourhood of the external meatus may become blocked with pus, and a small abscess forms, distorting the meatus and projecting externally. A caruncle when present usually projects from the orifice, and is situated on the posterior or lower edge. It forms a soft, red, warty excrescence resembling a raspberry, bleeding readily, and excessively sensitive. The extent can only be ascertained by examination with a speculum. Malignant growth of the urethra is rare. It appears as a red nodular induration at and beyond the urethral orifice.

On *palpation* the normal urethra can be rolled between the finger and the concavity of the pubic symphysis, forming a short cord slightly movable laterally. This is thickened and intensely tender in urethritis, and hard and indurated in malignant growth. By squeezing the urethra forwards, a drop of pus may be expressed in chronic urethritis. Occasionally a bead of pus may be seen to exude on pressure from the large glands immediately internal to the meatus.

The mucous membrane of the urethra is examined by means of a wire speculum, or a urethroscopic tube. Watson's wire speculum consists of two bent wires which, at rest, lie in apposition along their whole length. They can be separated by a screw at their proximal ends, and at their distal ends. Light is obtained from an electric head-lamp or reflected from a head-mirror.

Before examining the urethra, the bladder should be completely emptied with a rubber or glass catheter. If this is not done, urine floods the urethroscopic field when the tube is pushed to the internal meatus, and causes much delay from the repeated mopping which is necessary. A few drops of cocaine solution (1 per cent) are run into the urethra by means of a glass pipette with a rubber teat, or a small pledget of cotton wool soaked in cocaine solution is pushed along the canal with sinus forceps, or introduced on a wool carrier, and is allowed to remain in place for three minutes, and then removed. The speculum is introduced closed, and the wire blades separated by means of the screws. A beam of light is projected into the urethra from an electric head-lamp, and the mucous surface is dried by means of a pledget of wool on a long fine wooden or metal wool-carrier.

A Kelly's tube of moderate calibre may be used in the same way, instead of the wire speculum. Casper's and Wyndham Powell's urethroscopes constructed for examination of the male urethra, are equally useful in the female, the air-distension apparatus being removed. The instrument consists of a handle with an electric light intensified by a bull's-eye lens, and reflected into the central axis of the tube by means of a mirror set at an angle, a hole being provided in the centre of this through which the observer looks. Fixed at a suitable distance from the light, and in the proper axis, is a funnel which fits into the proximal end of the urethroscopic tube. The tubes are of 24, 26, or 28 French millimetre scale. The urethra is anaesthetized as before, and the urethroscopic tube, with the plunger in place, passed along the urethra until the end lies in the bladder. The plunger is removed, and any urine that escapes is allowed to run off and then mopped up with pledgets of wool on carriers. The urethroscope is now fitted to the tube, and the light switched on. The tube is slowly withdrawn, examining the mucous surface as it passes before the open end.

The mucous membrane shows longitudinal folds which appear in the field separated by furrows radiating from a central depression. Blood-vessels can be distinguished running in a longitudinal direction. The orifices of urethral glands are seen as small oblong red spots.

In an acutely inflamed urethra the folds are swollen and puffy and intensely red. All details of fine structure are lost : pus fills the central depression, and wells out from the furrows between the oedematous folds. The mucous membrane is easily torn, and bleeding occurs. In chronic urethritis the infection is confined to the glands and the area immediately surrounding them. The orifices are widely open, and are surrounded by an intensely red halo of inflamed mucous membrane. Pus may be seen exuding from the orifices as they appear in the urethroscopic field, after being pressed upon by the urethroscope tube.

In urethral caruncle the bright red granular excrescence can be followed up the posterior wall, frequently to within a short distance of the orifice of the bladder.

Persistent bleeding from injury to the delicate surface of the vascular growth may interfere with the examination, and is met by introducing a pledget of wool in a holder soaked in adrenalin (1 in 1000). Pouching of the posterior wall of the urethra occasionally occurs, but I have seen no case where the orifice of a pouch was so defined or narrow as to form a satisfactory urethroscopic picture.

A malignant growth of the urethra (squamous epithelioma) which I examined showed an irregular, nodular, readily-bleeding surface extending the whole length of the urethra and involving the whole circumference at the deeper part but only the left lateral and posterior walls as it approached the external meatus.

B. The Bladder

Examination of the Bladder.—The fully distended bladder can be felt and seen as a rounded swelling above the pubes. The partly distended or empty bladder lies in the pelvis behind the pubic bones, and cannot be felt. The base of the bladder is in contact with the anterior wall of the vagina, and a considerable portion of it can be palpated by the finger in the vagina.

On the anterior wall of the vagina, the urethra can be felt and rolled on the pubic symphysis. Above this the outline of the trigone can occasionally be felt in a lax subject, and on each side the ureters may be traced passing outwards and backwards round the upper part of the anterior and lateral walls of the vagina. The thick hard ureter, which is so frequently found in tuberculosis of the kidney and ureter, can easily be felt and rolled under the finger. The position of the ureter on the lateral wall of the vagina is lower than one would expect from anatomical descriptions. The bladder-wall behind the trigone can be palpated for about an inch and a half backwards from the base of the trigone before the cervix uteri is reached by the examining finger.

Fistula.—It is in the region of the trigone that urinary fistula, the result of sloughing after child-birth, or of gynaecological operations, or of vaginal operations for stone in the bladder or ureter, is found. The fistula may be small, and on examination with a vaginal speculum a small prominent bud of mucous membrane darker and smoother than that of the vagina is seen. In the more severe grades a defect of considerable extent, admitting one or two fingers, may exist. The mucous membrane of the bladder prolapses into the vagina at the edges of the fistula, and the opening is surrounded by dark purple folds which frequently show ulceration.

The urine trickles away continuously from the larger fistulae. When the fistula has followed total hysterectomy the scar of the operation renders the upper part of the vagina rigid, and the opening of the fistula may lie in the scar-tissue. In this case the opening is small, and is surrounded by a bud of granulation tissue.

It is important to ascertain if the ureter is involved in the fistula. Rarely the orifice of one ureter may be found in the prolapsed mucous membrane of an extensive defect and the efflux seen. When the fistula is extensive the bladder is collapsed and contracted, and cystoscopy is impossible ; but in the case of a small fistula the bladder can be distended, and the ureteric orifices examined cystoscopically. This may be assisted by plugging the vagina in order to prevent the fluid escaping from the bladder.

The fistulous opening in the bladder is surrounded by inflamed and oedematous mucous membrane, and it may be difficult to see the orifice of the fistula or to identify those of the ureters. The most difficult cases to investigate are those where the fistula opens on the scar of a hysterectomy, and the question as to whether the bladder or ureter is involved, and if the ureter, which side is injured, will be raised.

A catheter should be passed, and the bladder filled with methylene-blue solution. If this escapes by the fistulous opening, the bladder is involved, but if clear urine continues to escape, the fistula is connected with the ureter. The examination of the ureters to detect the side involved, and the position of the fistula, will be discussed later.

Stone in the bladder cannot be felt from the vagina unless it is of very large size, when the thickened, contracted bladder can be felt between the fingers in the vagina, and those of the left hand above the pubes. The condition is rare in women.

Papilloma of the bladder can be detected only in exceptional cases. A large solitary pedunculated papilloma in a thin subject can sometimes be felt as a soft rounded mass which moves freely between the fingers on bi-manual examination.

Thickening of the bladder-base from *malignant growth* can be felt from the vagina when the growth has infiltrated the muscular wall of the bladder. In the early stage, before such extensive infiltration of the bladder wall has occurred, the growth will probably not be detected with the finger. It is unsafe to assume that a malignant growth is not present, or that a growth known to be present is not malignant, because it cannot be felt from the vagina or bi-manually. In a case of severe purpura haemorrhagica I have felt a massive infiltration of the wall of the bladder with blood. The mass projected suprapubically like a distended bladder, and could be felt from the vagina. There was moderate haematuria, and the cystoscope showed the mucous membrane thrown into great opaque brown folds by the infiltrated blood.

Examination of the interior of the bladder by the finger introduced through the urethra is still occasionally practised. It is mentioned here only to be condemned. In order to carry out the examination the urethra must be dilated to so large a calibre that the mucous membrane is lacerated at the ureter orifice and the muscular wall is ruptured. In a certain proportion of cases the sphincter action of this muscle is regained. In a large proportion the sphincter action is lost or impaired, and incontinence of urine, causing lifelong misery, is the result.

Moreover, the information obtained by the examination is extremely limited, and cannot be compared with that gained by any of the modern methods of cystoscopy. The finger advances into the bladder only a very short way, and only gross irregularities situated in the immediate neighbourhood of the internal meatus, or on the anterior wall immediately superjacent to it, can be detected. The method should be completely abandoned.

Cystoscopy

There are two methods of cystoscopy, the open or direct, and the indirect.

Direct or Open Cystoscopy.—This method was introduced by H. A. Kelly in 1893, and has been modified by Luys and others. Kelly's method consists in distension of the bladder with air by atmospheric pressure, and examination through a straight open tube, by means of reflected light.

The instruments necessary for carrying out Kelly's method are as follows: (1) an electric droplight, (2) head-mirror, (3) calibrator and dilator, (4) vesical specula, (5) evacuator, (6) searcher, (7) solution of cocaine, (8) pledgets of wool on holders.

Kelly uses a head-mirror and reflected light. A powerful electric head-lamp is an improvement, as it dispenses with an assistant's hand holding the electric droplight. It has, however, the disadvantage that it adds to the special apparatus which must be carried if a journey is undertaken. The calibrator and dilator is conical, and is graduated in millimetres from 6 to 16. Kelly's specula are plated metal cylinders 3½ inches long, and of the same diameter throughout. There is a funnel-shaped expansion at the outer end of the speculum, and a handle 3 inches long is attached at an angle to the funnel. The specula are made in various sizes from 5 to 20, each number representing the diameter in millimetres. Each instrument has an obturator, which is used during introduction. The evacuator consists of a rubber exhausting bulb, and 14 inches of fine rubber tubing, and, at the bladder end, a small, hollow, perforated metal ball. Recently Kelly has introduced a glass bottle with perforated cork, into which the suction apparatus draws the fluid. The searcher is a long, fine probe on an angled handle.

handle is turned upwards, and the obturator is removed. The room is now darkened, and the droplight held by an assistant over the sacrum of the patient, and the light reflected into the bladder by the head-mirror, which is carefully adjusted to the proper angle in front of the examining eye, or a head-light may be used as in Fig. 34.

Some fluid almost always remains in the bladder, even after careful catheterization, and this wells into the tube as it is moved about, or from the movements of the abdominal muscles of the patient. This fluid is allowed to run into a receptacle, by tilting the outer end of the speculum downwards, and, if necessary, using the suction apparatus. Kelly recommends that in order rapidly to empty the bladder, the patient should be directed to rise up vertically on her knees. The interior of the bladder is now systematically examined.

One inspects the posterior wall and the ureters by looking directly upon the surfaces, more or less at right angles to the plane of vision. Looking at the lateral wall, there is some foreshortening, so that a larger area is seen. In order to inspect the base of the bladder, the handle of the speculum is dropped decidedly, and the operator stoops down or kneels upon a cushion on the floor, and directing the mirror at a greater angle from the eye, he views the greatly foreshortened base. If he desires to inspect any particular part of the base more minutely, this is done by lifting up the mucosa with the upper edge of the speculum, which brings the particular area in question more into a plane at right angles to the axis of the speculum. The trigonum is inspected by drawing the speculum out until the internal urethral orifice begins to close over it, then pushing it in two or three millimetres, and turning it from side to side, the more hyperaemic trigonum is easily seen (Kelly).

Indirect Cystoscopy.—The first instrument by which the interior of the bladder was viewed through a system of lenses with an internal electric light as an illuminant, was introduced by Nitze in 1879, and the modern cystoscope, with its numerous varieties and modifications, is the outcome of this instrument. In its simplest form the Nitze cystoscope consisted of an optical apparatus and an illuminating apparatus combined. The optical apparatus consists essentially of three lenses which give an erect and slightly enlarged figure.

(*a*) The objective situated at the vesical extremity of the cystoscope is a converging lens which gives an inverted image. This image is larger or smaller than the actual object, according to whether it approaches or recedes from it, respectively. On the other hand, the extent of the field viewed is smaller the nearer the lens approaches, and greater the farther it recedes from the wall of the bladder.

(*b*) The intermediate lens is similar to the objective, but reversed. It reverts the image to its upright position, and enlarges it to its original size.

(*c*) The ocular is a simple lens with a short focus which magnifies the image.

The amount of magnification depends upon the power of the ocular, but as the magnification increases, the illumination of the picture seen by the eye becomes feebler, and the extent to which the magnification of the ocular can be carried is limited by the reduction in the light. In order to obtain a good illumination, the field should not exceed 3·5 cm. in diameter. The distance from the objective to the object examined, at which the object is seen at its proper size, is 3 cm.

In order to obtain a view of the part of the bladder-wall fully illuminated by the cystoscope lamp, the window at the vesical end of the cystoscope must lie at right angles to the axis of the tube in which the lenses are set. This is attained in the Nitze cystoscope by placing a mirror at an angle of 45 degrees to the axis of the tube, and the inner window of the cystoscope. As a result the image is inverted, that is to say, if an arrow with the point upwards be viewed it will be seen with the point downwards. The image is not, however, transposed transversely, so that if a second arrow be placed across the first, with its point to the right, it will be seen pointing to the right. In order to rectify this, E. Frank introduced a prism into the optical system. Ringleb uses a prism to divert the image into the axis of the telescope: the size of the window of the optic is enlarged from 0·2 mm. in the Nitze, to 0·4 mm., and a diaphragm is introduced into the optical system to cut off aberrant rays. There is a complicated system of lenses. The effect is that a very clear, sharp, magnified image is obtained of near objects, but distant objects are not so well seen as in the Nitze system.

The illuminating apparatus consists of a small incandescent lamp in a metal hood, which is attached at an angle to the shaft of the instrument, and sheds its rays on the field to which the window of the cystoscope is directed. The filament of the lamp terminates at one end in the metal wall of the hood, which connects it with the metal shaft of the cystoscope, and at the other in a fine coiled wire, which, when the lamp is screwed in place, comes in contact with a small metal plate, the terminal of an insulated wire in the wall of the shaft of the cystoscope. The lamp may have a carbon or a metal filament, the latter being easily recognized by its fine white metallic appearance. A carbon lamp requires a current of 6 or 8 volts, while a metal-filament is lit by one of 4 volts. The metal-filament lamp, with its low voltage, allows of a much smaller battery being used, and the illumination is much more powerful. The disadvantage of these lamps is that they are easily fused by a too powerful current, and, being fragile, are readily broken by jarring. With reasonable care, however, the life of a metallic-filament lamp may be prolonged.

Connection with the source of the electric current is obtained by flexible insulated wires, and a metal contact. The latter is in the form of a double metal semicircle which fits into a deep groove at the ocular end of the cystoscope, and swings round as the instrument is turned in the bladder. There is a switch on this contact.

Irrigation Cystoscope.—In order to avoid the preliminary introduction of a catheter, and to overcome the difficulty of the medium becoming clouded from the mixture of blood or pus during the examination, and consequent removal and re-introduction of the cystoscope, the irrigation cystoscope has been introduced. In this the optical apparatus is separated from the illuminating apparatus, so that the former becomes a telescope and the latter a light-bearing catheter.

The illuminating apparatus consists as before of a terminal lamp set at an angle and a shaft. The shaft is hollow, and there is a large lateral eye at the vesical end of the tube, facing the area illuminated by the lamp. At the proximal or outer end of the shaft is a valve, to prevent the escape of the fluid when the bladder is being filled. The valve in the German cystoscope consists of a trap-door held in position by a double spring, working in a chamber at the outer end of the tube. In the author's modification there is no chamber in the lumen of the cystoscope. The valve acts like a vertical piston, with the spring placed in a chamber outside the lumen of the tube. The piston is bevelled so that the pressure of the telescope can push it downwards. In order to allow of washing and filling the bladder, a hollow spigot is provided, and is passed through the valve, being withdrawn when the irrigation is complete. The ocular apparatus is in the form of a telescope, which is pushed along inside the metal catheter.

If continuous irrigation is desired, a double-way metal catheter can be introduced instead of the telescope, and the bladder is washed without removing the light-carrying metal catheter. The size of the ordinary irrigation cystoscope is 23 F., but smaller sizes may be obtained, and are useful when the urethra is narrow, or in children (16 F. and 15 F.).

The length of the shaft measured from the metal contact to the window, that is the part of the cystoscope available for lying in the urethra (male), varies from 7¾ inches in the small child's cystoscope, to 9½ inches in the recent form of the Ringleb cystoscope. The latter measurement is sometimes advantageous in a stout male subject, especially when the urethra is elongated by enlargement of the prostate gland.

Retrograde-Vision Cystoscopes.—In order to obtain a vertical view of the part lying immediately around the internal meatus, a specially constructed cystoscope has been introduced. Nitze placed the window on the angled beak of the cystoscope, so that it looked backwards along the line of the shaft, and by using a double prism deflected the image into the proper axis. Schlagintweit used a prism which was raised into position over the window by means of a screw apparatus similar to that which elevates the ureteric catheter in a catheterizing cystoscope. These instruments have a very limited application.

The Source of Light.—The most convenient source of light is a small dry cell battery of 4½ or 8 volts. Two small dry cells of 4½ volts may be connected, and placed in a small case. They are cheap, easily carried, and readily replaced, and the voltage is sufficient for a metal- or a carbon-filament lamp. In order to modify the current, a finely graded small rheostat should be used, and is carried in the cystoscope box, and used with the small dry-cell battery. This may also be used with larger batteries or accumulators, or added to one pole of the large rheostat when the main current is employed, in order to give a very fine graduation of current and protect the delicate cystoscope lamp. Accumulators may be used, and are easily charged by means of a small apparatus from the main. They are more cumbersome, and are more likely to be found out of order than the dry batteries described.

When the main electric current is used, a fixed rheostat is necessary for the constant current, and a transformer for the alternating current. A panteostat, when available, will give a finely graded and safe current.

Catheterizing Cystoscopes.—A special cystoscope is required for catheterization of the ureters, and a variety of catheterizing cystoscopes are on the market. In its simplest form the catheterizing cystoscope consists of a cystoscope of the Nitze type on the upper surface of which is a tunnel along which the ureteric catheter passes. This tunnel stops short of the window on the concave surface of the beak. A disadvantage of this cystoscope is that it must be removed in order to wash the bladder, should the medium become clouded with blood or pus.

The more useful type is an irrigating cystoscope such as that previously described, to which the catheterizing apparatus is added. With this instrument only one introduction is necessary for the lavage, distension of the bladder, and catheterizing the ureters; and should the medium become cloudy during the examination the bladder can be washed without removing the instrument.

Ureteral Catheters.—Ureteral catheters are constructed of a very fine woven silk basis, covered with a special preparation which gives a smooth surface. They are 30 inches in length and of varying sizes, from 4 to 8 Charrière. The most useful sizes are Nos. 5 and 6. In some cases the ureteric orifices are very small, or the catheter is arrested after it has entered about an inch, or one and a half inches, into the ureter. In such cases a No. 4 catheter will frequently pass when the larger size has failed. Pasteur uses the Bénique measurements, which are half those of the Charrière scale. Thus, the numbers are double, and those given above would read 8 to 16.

The catheter should be supple without being too rigid. A catheter which is too pliable and soft, is useless. The tip of the catheter may be olivary or rounded, or it may be cut transversely, or obliquely, with an open end. The most generally useful are those with a rounded end. The olivary-tipped catheter may be required in cases of difficulty in entering the ureteric orifice.

There should be two, or even three eyes. The first eye in the olivary or round-tipped catheters is situated laterally about ¼ inch from the end; in the others it is terminal. Behind the last or proximal eye, Albarran placed a thickening round the catheter, to prevent the urine escaping down the ureter alongside the catheter, but this is usually omitted.

The proximal end of the catheter should be cut obliquely, without any increase in the lumen. Some catheters have a trumpet-shaped extremity. This is unnecessary, and has the disadvantage of being too large to pass through the catheter tunnel, and the cystoscope can only be withdrawn, leaving the catheter in position, after cutting this end off with scissors.

The catheters I use are graduated in half inches of alternate black and brown, with one narrow red band at 6 inches, two red bands at 12 inches, and three at 18 inches. It is thus possible to tell with certainty, the distance the point of the catheter has travelled up the ureter. The outer end of the catheter is cut obliquely, without the addition of a trumpet-shaped extremity.

A wire stilette is provided with ureteral catheters, and is useful for ascertaining that the lumen is free. It should be removed before introducing the catheter.

Methods of Cleaning and Sterilizing Ureteral Catheters.—A number of methods are in use for sterilizing and preserving ureteral catheters.

1. *Sterilization by Vapour.*—They may be kept in a glass tube 32 inches in length and 1½ inches in diameter. The end of the tube is closed with a hollow rubber stopper containing a perforated metal box. A granular form of formaldehyde (tryoxymethylene) is placed in this box, and from this, fumes of formaldehyde are given off. A similar tube made of metal, may be used for travelling.

2. *Sterilization by Antiseptics.*—The catheter is sterilized by thorough washing in cold solution of biniodide of mercury (1 in 1000). A special syringe which fits the lumen of the catheter and has a capacity of 80 minims is used for injecting the fluid through the catheter. When this is thoroughly carried out the catheter can be rendered completely aseptic.

3. *Sterilization by Heat.*—If care is exercised the ureteral catheter may be

boiled. It is wrapped in gauze, or placed in a fine canvas bag, and placed for two or three minutes in boiling water (without the addition of soda). It is then plunged into cold biniodide lotion, and the gauze covering removed. Care is taken not to touch the catheter with forceps when it is hot and soft, as the surface will be frayed and broken by the contact. Catheters are soon destroyed by boiling, if it is repeated, but with care, may be sterilized in this way twice or three times.

Another method is sterilization by steam, under pressure. Each catheter is placed in a cotton cover which projects for an inch beyond each end. Two or more catheters are rolled up, and placed in a flat metal box, which is sterilized by steam at 16 lb. pressure (240° F.) and dried by vacuum. The box is sealed and ready for carriage. For use, the metal box is opened by tearing off the metal strip, and a catheter inside its cotton cover removed. When the cystoscope is in position, the end of the catheter cover is cut off with sterilized scissors : the open end of the cover slipped over the end of the catheter tube of the cystoscope, and clamped in position with a small clamp. The catheter can now be introduced into the tube, by manipulation with the fingers outside the cover, without actually coming in contact with the catheter at all.

After use a catheter is thoroughly washed through with biniodide of mercury solution by means of the ureter syringe. It is then dried carefully with sterile gauze, and its surface rubbed with a little sterile oil on a piece of gauze. A drop of oil is injected by the syringe, or is carried into the lumen by dipping the wire stilette in oil, and introducing it. The catheter is then coiled, and laid aside in an enamelled tray. After use in a virulent infection of the kidney, the catheter should be destroyed ; and any catheter which shows roughening or cracking of the surface, or fraying at the eye, should be discarded.

Methods of Sterilizing Cystoscopes.—I have found the following method of sterilization by antiseptics quite efficient. The cystoscope is washed thoroughly with ether soap. The valve is unscrewed and placed in boiling water. If it is a catheterizing cystoscope, the screw cap at the end of the catheter tunnel is removed and boiled, and the catheter tunnel is syringed through with methylated spirit. The ether soap is removed with sterile water, and the cystoscope is then thoroughly washed with biniodide of mercury solution (1 in 1000), particular care being taken to cleanse the lamp, and the catheter elevating apparatus. The cystoscope is then placed in biniodide of mercury solution, either standing erect in a tall glass jar, or lying in a shallow dish completely covered with lotion. If an infected case has been examined, the instrument should be placed in biniodide solution over night, after being thoroughly cleansed in the manner described.

Accessory Instruments for Cystoscopy.—A narrow external meatus in the male or female may interfere with the introduction of the cystoscope. Kelly's dilator is useful for correcting this in the female. The tapering, detachable end of a bladder syringe may be used when other instruments are not available. For the male special metal dilators are made, but the ordinary graduated metal sounds are quite as efficient.

For the introduction of local anaesthetics into the urethra a ureteral syringe or pipette is used. A glass pipette with a rubber bulb is the most useful form of introducer, and is sterilizable by boiling. The anaesthetic solution is sucked up into the pipette by means of the rubber bulb, and gently expressed into the urethra. In very sensitive subjects a pledget of wool soaked in the local anaesthetic should be introduced into the external meatus, and allowed to remain for a few minutes.

The bladder is filled with fluid, from either a bladder-syringe or an irrigator. Bladder-syringes are of metal or metal and glass. The total capacity should be from 100 to 150 c.c. or about 4 or 6 oz. The syringe should have a glass barrel with metal mounts, and a hollow metal plunger. A syringe constructed entirely of metal is rather heavy, but has the advantage that it withstands repeated boiling. A glass barrel syringe cracks easily on boiling and should be sterilized by washing and soaking in biniodide of mercury (1 in 2000). After use it is cleaned with ether soap or methylated spirit and carefully dried.

An irrigator is suspended on a movable stand which can be raised and lowered. The reservoir is of glass, with a capacity of three pints or more, and rubber tubing connects this with a nozzle which fits the hollow plug of the irrigating cystoscope.

Unless prolonged washing or continuous irrigation is necessary, syringes are superior to an irrigator for filling the bladder for cystoscopy ; for the exact quantity introduced is much more easily ascertained, and the intravesical tension can be gauged by the pressure required to empty the syringe.

A variety of special tables are constructed for use in cystoscopic examination. Those of Pasteur, Legueu, Loewenstein, and Papin are examples. The objects aimed at are to support the patient in a semi-reclining posture, with the knees bent and widely apart and the feet supported. An operating table with leg-rests makes a satisfactory cystoscopic couch. The patient is placed in the lithotomy position, with the head and shoulders slightly raised by pillows.

Method of performing Cystoscopy in the Female Subject

Preparation consists in opening the bowels, or washing out the rectum with a large soap and water enema, and in rendering the urine antiseptic. For twenty-four hours before cystoscopy, and for the same period after the examination, the patient should be placed upon hexamine (hexamethylene tetramine), 10 grains being given thrice daily in a large tumblerful of water, between meals. The presence of free formaldehyde should be shown in the urine by means of the Rimini-Burnam test.

Before commencing the examination, the cystoscope should be thoroughly examined to see that all its parts are in working order. It is especially important to test the light. The patient may be examined in the dorsal position, or she may be placed in the lithotomy position, the surgeon being seated opposite the perineum.

The *dorsal position*, with the surgeon standing on the right side of the patient, is open to theoretical criticism, and is less comfortable for the surgeon. In practice, however, it will be found much less inconvenient than might be supposed, and is performed with a good deal less disturbance of the patient. It may be chosen by the surgeon on this account. The patient lies on the back on a fairly high couch, a large sand pillow being placed beneath the buttocks. The head is supported only by a small pillow, and the pelvis should be the highest part of the body. The knees are extended, and are widely separated, the thighs and abdomen being covered with sterilized towels, and a large pad of absorbent wool is placed beneath the thighs to prevent soiling during the bladder washing. The surgeon stands on the right side, and, during the cystoscopy, leans over the patient's right thigh.

In the *lithotomy position* the patient reclines on a special couch with the buttocks at the end of the couch, the thighs fully flexed, the knees widely apart, and the feet supported in rests. The back reclines on a sloping plane so that the patient is in a half-sitting posture.

The vulva, and vaginal, and urethral orifices are carefully cleansed with biniodide solution. If a vaginal discharge is present, the vagina should be thoroughly douched beforehand by the nurse with protargol (1 in 1000) solution.

In the female subject, anaesthetics, even local anaesthetics, may be dispensed with in the great majority of cases. The urethra is so slightly sensitive that patients very rarely complain of pain when the cystoscope is passed with reasonable skill. When, however, the bladder is known to be sensitive, as in cystitis, or the patient apprehensive, local anaesthetics may be used. In young women, in those of hypersensitive or of highly nervous disposition, and in cases where the bladder is known to be excessively tender and spasmodic, general anaesthesia is desirable. Chloroform is preferable to ether, as the deep respiratory movements under ether-anaesthesia may disturb the examination.

Local anaesthesia is produced by instilling 20 to 30 minims of cocaine solution (1 or 2 per cent) into the urethra by means of a glass pipette with a small rubber bulb. In addition to this, a small plug of cotton wool may be inserted just within the lips of the external meatus, and allowed to remain in position for a few minutes. A highly sensitive and spasmodic bladder may be anaesthetized by administering a vaginal douche of hot water containing 30 grains of antipyrin, and then introducing a wool plug soaked in the antipyrin solution into the vagina 10 or 15 minutes before the examination. By these means a bladder which has previously been too sensitive and spasmodic for satisfactory examination, will tolerate a moderate distension, and a skilfully conducted cystoscopy.

Spinal anaesthesia is a useful method in such cases, and may enable the surgeon to perform cystoscopy where local anaesthesia has failed.

The best lubricant is sterilized glycerine. The beak of the irrigation cystoscope, with the telescope in position, is dipped into a small beaker filled with this, and then introduced in the bladder.

The passage of the cystoscope rarely presents any difficulty in the female subject. The labia are separated with the fingers of the left hand, and the beak of the cystoscope introduced into the meatus, holding the shaft almost vertical at first, and then swinging it downwards in the middle line, and pushing it in meanwhile. A narrow meatus may necessitate dilatation, and readily yields to graduated bougies, or a Kelly's dilator ; or if these have not been provided, the cone-shaped nozzle of a bladder-syringe may act as an improvised meatus dilator. In introducing the cystoscope care should be observed to avoid contact with the labia, or the mucous membrane at the vaginal introitus with the beak of the cystoscope. Should this have occurred, the instrument must be carefully cleansed with a strong solution of biniodide of mercury (1 in 1000), and rinsed in sterile water or saline solution, before introducing it.

The telescope is now withdrawn, the drainage spigot inserted, and the urine drains away from the bladder. Some of the urine is caught in a small glass vessel, such as a medicine glass, and held up to the light to test its transparency. If the urine is quite clear, the surgeon proceeds at once to fill up the bladder, whereas if it is murky from pus or blood, washing of the bladder will be required. For filling the bladder a bladder-syringe or irrigator may be used. I prefer a syringe, as the quantity of fluid introduced into the bladder can be accurately measured, and the presence of spasm can early be detected by the pressure required to empty the syringe. The capacity of the bladder is about 10 oz., and about this quantity of fluid should be introduced for a cystoscopic examination.

The fluid may be plain sterilized water or salt-solution, or boracic solution. It should be agreeably warm to the finger (105° F.). Too hot or too cold fluid produces bladder spasm, and it may be some time before the bladder can be coaxed to expand sufficiently for examination, or the examination may have to be abandoned for the time being. The fluid is introduced slowly and steadily. Spasm may follow too rapid distension.

When haematuria is present, an absolutely clear medium must be obtained before distending the bladder for examination.

Where the urine is cloudy with pus and mucus, very thorough washing may be necessary before a clear medium is obtained. Large quantities of pus usually come from a diverticulum of the bladder, or from the kidney, pus and mucus from an inflamed bladder.

When the urine is alkaline, and extensive deposits of mucus and phosphates are found in the bladder, a preliminary washing with a weak solution of acetic acid (one or two drachms of acid acetic B.P. to one pint of water) is a material aid to clearing the surface. Similarly, when an abundant deposit of mucus and shreds clings to the walls of the bladder, in acid cystitis, a preliminary washing with an alkaline solution (sodium bicarbonate one drachm to the pint of water) will assist in obtaining a good view.

Spasm of the bladder is a difficulty not infrequently met with in cystoscopy. It may be produced by too rapid distension of the bladder, or the use of too cold or too hot solution. Usually, however, it results from cystitis, the bladder being contracted, and the muscle resenting dilatation.

The Cystoscopic Anatomy of the Bladder

In order to interpret cystoscopic appearances correctly, not only is a knowledge of the interior of the bladder necessary, but the examiner must also be familiar with the anatomical relations of surrounding parts to the bladder-wall. For the purposes of cystoscopy, the bladder may be said to have a base, lateral walls, an anterior and a posterior wall.

The extent of the *base* is not defined. It includes the trigone with the urethral and ureteric orifices, and an ill-defined area around these. A short distance behind the trigone the wall begins to rise somewhat abruptly, and in order to obtain a view of it, the beak of the cystoscope must be raised by depressing the ocular end.

The *apex* also is an indefinite term. It is marked in cystoscopic examination by an air bubble which invariably enters with the introduction of the catheter, and floats at the highest point of the bladder.

The *anterior* wall rises vertically from the anterior lip of the internal meatus. The trigone lies over the anterior vaginal wall, and its thickened muscular structure can sometimes be felt with the finger in the vagina.

For about an inch or one and a half inches behind the trigone the bladder wall is in relation to the anterior vaginal wall and the anterior fornix.

Behind this the *posterior* wall is in contact with the uterus, and in inflammatory affections of the uterus, an area of engorgement or of inflammation may be found here. On either side the bladder-wall is related to the broad ligaments. An area of the posterior wall lies above the level of the uterus, and is covered with peritoneum. Here the movements of the small intestine may be seen.

In using the cystoscope, the various parts of the bladder should be examined systematically. The routine method will vary with the individual surgeon, and also in different cases. But the systematic exploration of all parts should never be neglected if disastrous mistakes are to be avoided. A method which may be adopted for routine use may be described.

The cystoscope, on introduction, has its window directed upwards, and it should be noted that a small metal knob on the rim of the ocular indicates the direction of the window. The cystoscope is now turned a half circle so that the window looks directly downwards, and the light is switched on. The base of the trigone will at once come into view, and the trigone and ureteric orifices should be thoroughly examined. The trigone forms an area which is usually well defined from the rest of the bladder. The mucous membrane is uneven on the surface, sometimes it is furrowed in lines converging towards the urethra, more often the uneven surface follows no definite pattern. In colour it varies from a reddish yellow to a purplish red. The blood-vessels are prominent and coarse, and they converge towards the urethra. They branch and anastomose freely.

With the powerful lenses of the modern cystoscope, an interlacing network of fine vessels with small nodes at the junction of the anastomosis can be seen. The vessels may overlap slightly the base and lateral margins of the trigone. They differ widely from those of the bladder-wall. The base of the trigone is marked by a transverse ridge lying rather more than an inch behind the internal meatus. This ridge, the bar of Mercier, varies greatly in different subjects. It may be a well-marked rounded bar, or it may be flat and indistinct, the only indication of the base of the trigone being the number and appearance of the trigonal blood-vessels, compared with the lack of vascularity of the bladder wall.

If the bar of Mercier be followed out on each side, it will be found to become narrower and more prominent, and then gradually to sink and disappear where the bladder-wall rises to form the lateral and posterior walls. It forms on each side the lateral horns of the trigone. On the ridge where it is most prominent, just at the outer angle of the trigone, is a small red slit or dot which is the orifice of the ureter.

To the inexperienced cystoscopist, the search for the ureteric orifices presents many difficulties. In the great majority of cases, however, their discovery is quite simple, and the methods of finding them will be described in a later part of this article.

When the examiner has failed to find the orifice the urine may be coloured with indigo carmine, so that the efflux can be observed and traced to its source. This is done by injecting into the muscles of the buttock 5 c.c. of a 4 per cent solution of indigo carmine. After a quarter of an hour or more, usually half an hour, the urine is deeply tinged with blue, and can be seen as it shoots out from the ureteric orifice. The first part of the jet is usually too sudden and diffuse to track it accurately, but as the jet tails off into a dark ooze it can be clearly seen and traced.

The contractions of the ureteric orifice take place at intervals which vary on different occasions. When a great quantity of urine is being secreted the orifice will be seen to contract about every 10 or 15 seconds. The two orifices usually contract alternately. Long pauses are not uncommon under cystoscopic examination. Under the influence of the light, or the heat of the lamp, or from other unknown causes, the ureter may lie passive for one, two, or even more minutes. A ureteric contraction can usually be produced by pressure over the pelvis of the kidney, just below the costal margin. This appears to stimulate the pelvis to contraction, and the wave passes down the ureter.

A ureteric contraction may take place and the orifice gape without emitting urine. This occurs when there is a fistula of the ureter, but the continuity of the tube is not completely interrupted; it may occasionally be observed in a normal individual.

Passing now from the trigone and ureteric orifices, the general surface of the wall of the bladder is examined. This may be done by pushing the cystoscope on for a short distance, and then slowly sweeping it round in a circle, so as to examine the posterior, anterior, and lateral walls, and finally return to the original position. The higher part of the posterior wall is then examined by depressing the ocular end of the cystoscope, and the apex will come into view with its air bubble on turning the cystoscope so as to look upwards. In withdrawing the cystoscope towards the base the anterior wall is passed under review.

The mucous membrane of the bladder has a sandy yellow appearance. It is fine in texture and brilliant in its light-reflecting power. Here and there fine vascular twigs appear, and branch freely. There is no regularity of distribution or arrangement of these vessels. They appear from the deeper layers of the mucous membrane, and in the normal bladder are widely separated and show no tendency to anastomose. The numbers and size vary considerably within the limits of health. In many bladders careful inspection of the mucous membrane will show here and there a blue vein-like vessel coursing in the deeper layer of the mucous membrane and shining through. The fine vascular twigs mentioned lie superficial to these, and may be seen to cross over them. These blue vessels are the larger arterial branches in the deeper layers of the mucosa. Occasionally such a vessel may be seen rising to the surface, and splitting into two or more of the fine vascular twigs already described. In a peculiar form of engorgement of the vessels of the mucous membrane, the fine surface-arterioles form a closely-set, freely-anastomosing, fine network, and beneath this numerous larger vessels of the deeper layers shine through.

In the fully distended bladder some tracery of the muscle-bundles underlying the mucous membrane, may be seen. In the normal bladder there are no deep depressions or prominent muscle-bundles to throw shadows or form ridges on the smooth surface.

By turning the window of the cystoscope upwards, and withdrawing the instrument so that the window lies partly in the urethra, the edge of the urethral orifice will be seen. One part of the field is occupied by a dull red, almost opaque curtain. Towards the free edge this becomes paler and translucent, and the margin is slightly concave. The part that is being examined is the anterior lip of the meatus. By turning the window round, the edge will be seen to be concave all round, until the window looks downwards at the posterior lip of the meatus when the sharp margin can no longer be seen as the window is turned on to the apex of the trigone. In order to get a view of the profile of this part of the circumference the ocular portion of the cystoscope must be depressed. The margin is here slightly convex.

Changes in the Bladder due to Enlargement or Disease of neighbouring Organs

Pregnancy.—During pregnancy, and especially in the later months, the bladder mucous membrane is much darker in hue, and dull in appearance. It is on this account more difficult to illuminate. The vessels are engorged, and appear more numerous and larger, and large veins may be seen coursing beneath the mucous membrane. The trigone participates in the vascular engorgement, which may be more prominent here than elsewhere. The lips of the ureteral orifices may be puffy and thick, but are frequently quite normal in appearance.

During the early months of pregnancy, some bulging in of the posterior wall may be observed, and about the third or fourth month this may be pronounced. In the later months of pregnancy there is considerable difficulty in distending the bladder, the reduced capacity being due to pressure on the posterior wall. A distension of a few ounces can always be obtained, and frequently the bladder has almost a normal capacity. I have had occasion, in a few cases, to catheterize the ureters in the eighth or the beginning of the ninth month of pregnancy, and have met with no unusual difficulty in making the examination. The pelvis should be elevated on a firm pillow to obtain as much room in the pelvis as possible.

Fibromyoma of the Uterus and Ovarian Cysts.—When the tumours reach a large size pressure is exerted on the posterior wall of the bladder. The wall bulges downwards, and the form of the bladder is considerably modified. There is difficulty in obtaining a satisfactory distension of the bladder. After a few ounces have been injected the fluid is returned. On cystoscopy the cavity is less brilliantly illuminated, and the cystoscope is manipulated with difficulty. The cavity is found to be distorted by the downward bulging of the posterior wall.

Malignant Growth of the Uterus.—In malignant growth of the uterus and vagina, extension to the wall of the bladder, and obstruction of the ureters from pressure or invasion of the wall of the tube, occur in the late stage. Cancer of the cervix which has spread to the vaginal wall, is the form of malignant disease which is most frequently encountered. That portion of the bladder-base lying immediately behind the trigone, and the trigone itself, are the parts usually invaded. Rigidity of the bladder-wall, with engorgement of the vessels, and the raising up of stiff-looking folds, are signs of invasion of the bladder-wall. When the infiltration is extensive, and the lymphatics are blocked by the growth, oedematous folds or areas of bullous oedema are observed. When the growth infiltrates the mucous membrane, the whole base of the bladder is raised up and rigid, and the altered contour can be felt on introducing the cystoscope : the ocular end of which must be fully depressed in order to ride over the prominent base.

The mucous membrane is raised in irregular, firm-looking, infiltrated masses, and in parts there is ulceration. The ulcers are very irregular, with necrotic tissue adhering to the base and edges, and frequently with deposits of phosphatic material. The ureteric orifices are difficult to find, and may be entirely hidden in or behind irregular prominences. Oedema of the ureteric orifice may be present where the ureter is compressed by the growth.

In judging as to the extent of the growth, in view of operation, the absence of cystoscopic changes in the mucous membrane of the bladder cannot be held to prove that the bladder-muscle has not been invaded. Exploration of the growth with the finger in the vagina is a more reliable guide.

Displacement of the Uterus and Cystocele.—Changes in the bladder-wall have been observed in anteflexion and anteversion, and in retroflexion and retroversion. In anteflexion and anteversion the uterus forms a prominence, more or less distinct, on the posterior wall of the bladder. The retroverted uterus raises the base of the bladder by the projection forwards of the cervix. As a result, the ureteric orifices are wide apart and difficult to find, and the lateral recesses of the bladder are more easily recognizable than in the normal bladder.

In prolapse of the uterus and dropping of the anterior vaginal wall, the base of the bladder which is adherent to the vaginal wall, sinks, and when the condition is pronounced, forms a cystocele. Many degrees of the condition are found. The portion of the bladder-base behind the trigone is the first part affected, and the trigone retains its position. In the more pronounced degrees, the trigone became involved, and a deep pouch forms where the trigone and bladder-base formerly lay. The exploration of this by the cystoscope is accomplished by elevating the eyepiece so as to depress the beak. Difficulty may be experienced in finding the ureteric orifices owing to the formation of numerous folds of mucous membrane which conceal the interureteric bar; and also from the position of the trigone and orifices which lie on the anterior wall of the fully-developed cystocele. The cystocele may be invaginated into the bladder by pushing it up from the vagina, but it presents many folds and furrows so that there is difficulty in recognizing the trigone.

Inflammation of neighbouring Parts and Organs.—In salpingitis and pyosalpinx an area of inflammation is frequently found on the wall of the bladder, behind the trigone on the posterior wall, to the right or left of the middle line, according to which tube is diseased. In metritis, the posterior wall may show cystitis. A patch of cystitis is likewise seen before the formation of a fistula, between the bowel and the bladder, and at any part of the bladder-wall which is in immediate contact with an area of acute inflammation. In a case of prevesical abscess I have seen an area of the anterior wall of the bladder covered with oedematous processes and nodules, closely resembling a growth of the mucous membrane.

Fistula.—The three principal varieties met with in the bladder are fistula between an abscess (including pyosalpinx) and the bladder, fistula between the bowel and the bladder, and fistula between the bladder and the vagina and uterus.

1. *Fistula between a Pyosalpinx or other Abscess and the Bladder.*—The signs of an abscess in the pelvis are accompanied by cystitis. The symptoms of suppuration diminish, while those of cystitis persist or increase. Cystoscopy can usually be performed without difficulty. Occasionally the symptoms of cystitis are very slight or entirely wanting.

The cystoscope may show very little change in the mucous membrane, with the exception of an area of cystitis immediately surrounding the fistula. The orifice of the fistula is hidden in a ring of oedematous mucous membrane, or there may be an irregular opening of variable size, and this is occasionally surrounded by radiating folds of thickened mucous membrane. Purulent fluid may be expressed by the finger in the vagina, or there may be a thick tape-like pipe of semi-solid pus.

2. *Fistula between the Bowel and the Bladder.*—This may be connected with the small bowel, the appendix or caecum, or the rectum. There are dense adhesions uniting the surrounding bowel to the bladder, and there is usually an intermediate abscess-cavity, and sometimes a long tortuous tract. The opening of the fistula may be hidden behind a high fold or ridge of the bladder-wall, so as to be invisible to the cystoscope, or it may lie on the even wall, and inspection present no difficulty. The position of the opening is no criterion as to the level at which the fistula opens into the bowel. The general surface of the bladder is usually remarkably clean and healthy, a ring of inflammation, frequently quite limited in extent, surrounding the orifice of the fistula.

Immediately around the fistula are grouped oedematous masses like sago-grains. The actual opening may not be visible. Occasionally a small brown faecal mass may be observed projecting from the fistulous opening.

3. *Vesico-vaginal Fistula.*—When the fistula is large no urine is retained in the bladder, and the organ becomes contracted, so that cystoscopy cannot be performed. A small fistula may be plugged by a vaginal tampon, and cystoscopy carried out. The vesical mucous membrane prolapses into the vagina, and the appearance of the fistula from the bladder aspect is not unlike the orifice of a diverticulum. The surrounding mucous membrane is puckered, and thrown into folds which radiate from an orifice of varying size situated on, or behind, the trigone. In a small fistula little more than a depression surrounded by inflamed mucous membrane can be seen.

Diverticula.—Large diverticula of the bladder are congenital, and occur in an unobstructed bladder. Usually one, less frequently two, and rarely more than two may be present. The most common seat of the orifice is at the lower part of the bladder behind, and in close relation to the ureteric orifices. A diverticulum may, however, be found opening in the upper part of the bladder. An imperfectly obliterated urachus may form a depression or sac at the apex of the bladder.

The general surface of the bladder is healthy. The orifice of the diverticulum forms a round or oval opening which appears as a sharply defined black area. On close inspection, the edge of the orifice is rounded, the mucous membrane is thrown into folds and puckers, as if it were being dragged into the diverticulum. Blood-vessels approach the edge, pass over it, and disappear. Around the orifice may be found an area of trabeculation. The size of the orifice varies greatly. In a large diverticulum it may be the size of a sixpenny-piece, often it is smaller.

The residual urine in a diverticulum frequently becomes infected, and the patient suffers from persistent subacute cystitis, with constantly recurring attacks of acute cystitis.

Cystoscopic examination may be very difficult owing to the spasmodic condition of the bladder, and the massive oedema which frequently surrounds and conceals the orifice of the diverticulum.

A calculus or a number of calculi may form in a diverticulum, but as a rule cannot be seen by the cystoscope. A malignant growth sometimes develops on the edge of the orifice of the diverticulum, and may conceal the opening from view. The investigation of diverticula after their presence has been ascertained by the cystoscope, is carried out by means of the X-rays, and the injection of bismuth emulsion or collargol solution.

Varicose veins of the bladder are frequently diagnosed in order to explain haematuria of obscure origin. The condition is, however, rare, and in my view it is doubtful if they ever give rise to spontaneous haemorrhage, apart from catheterization.

A large solitary varicose vein is sometimes found on cystoscopy. Usually it lies in the neighbourhood of one of the ureteric orifices, and pursues a tortuous course. In only one case have I seen a really extensive varicose condition of the veins of the bladder. This was in a woman who had pyelitis and slight cystitis and had suffered from thrombosis of the femoral veins on both sides.

The trigone and an area around it were the seat of a congeries of prominent very tortuous veins. The rest of the bladder showed the same appearance to a very much less degree. There had been no haematuria. It is likely that the thrombosis had extended into the iliac veins.

Cystitis

Inflammation of the bladder assumes a great variety of characters, only some of which admit of cystoscopic classification. The broad division into acute and chronic cystitis is recognized cystoscopically only in cases where lesions are very extensive, and the acuteness or chronicity pronounced.

In most cases the cystoscopic appearances are those of an acute inflammation, even where the cystitis may have persisted for many months, and may fairly be classified clinically as chronic (Plate VII. Figure A). A further point that will strike the cystoscopist is that in the majority of cases of cystitis the lesions affect only some part of the bladder, and that an inflammation which affects the whole surface of the bladder mucous membrane is comparatively uncommon.

The propriety of performing cystoscopic examination in acute cystitis is open to doubt. The difficulties of obtaining a satisfactory view of the whole interior of the bladder in the acute stage of a severe cystitis are considerable, owing to the extreme sensitiveness of the organ; the intense spasm which is provoked by distension of the viscus, and the tendency for slight oozing to occur and to persist, are factors that militate against a satisfactory examination. And, moreover, it is not unlikely that the severity of the symptoms may be aggravated, and even that further extension of the inflammation of the renal pelvis may follow a prolonged attempt to overcome these difficulties. Unless there is some very urgent reason to the contrary—and it is difficult to conceive the conditions under which such urgency would arise,—cystoscopic examination should be postponed until the subacute stage has been reached. At this stage, and more especially when the cystitis is tending to become chronic, cystoscopic examination usually throws valuable light upon the cause, and aids the treatment of the cystitis.

Chronic Cystitis.—It has already been noted that in many cases of chronic cystitis the cystoscopic appearances are those of an acute inflammation. In old-standing cystitis the general surface of the mucous membrane is more likely to be uniformly involved than in a recent acute cystitis.

The obstructed bladder to which chronic cystitis is superadded presents a characteristic appearance. There is trabeculation and sacculation. The mucous membrane has a uniform dull reddish-brown colour, and sometimes a greyish tint. No blood-vessels can be distinguished. Brown patches may be seen from old haemorrhages. There are shreds of partly adherent mucus. A peculiarly velvety appearance is sometimes found, resembling a low sessile papillomatous growth. Patches

PLATE VII. Vol. III.

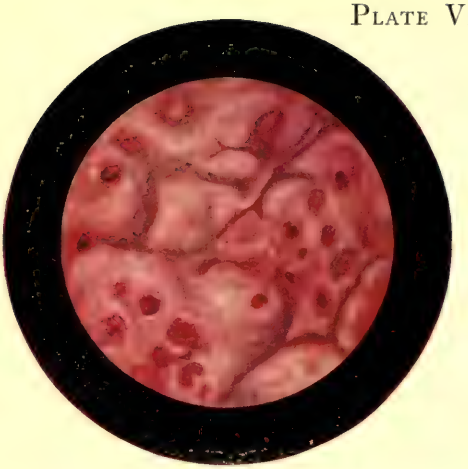

FIGURE A. Acute haemorrhagic cystitis.

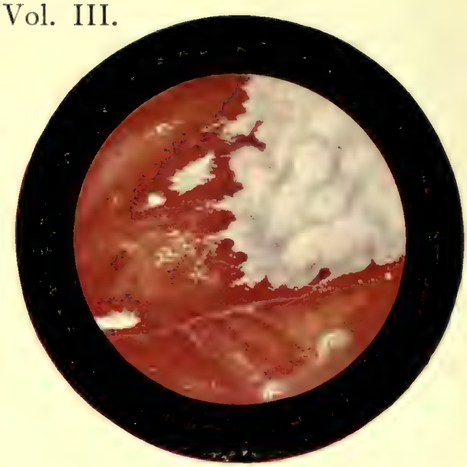

FIGURE B. Cystitis with phosphatic deposit.

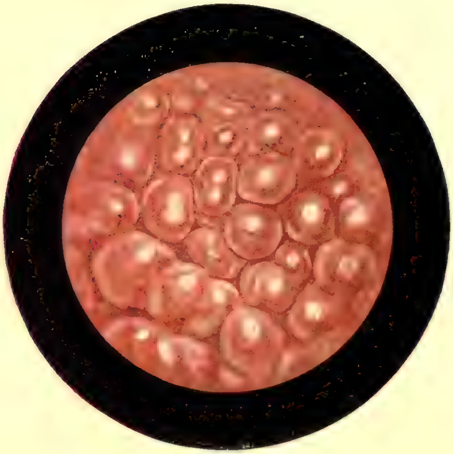

FIGURE C. Bullous Cystitis.

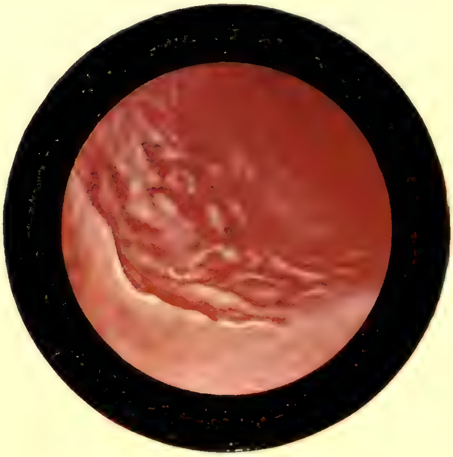

FIGURE D. Extensive superficial ulceration.

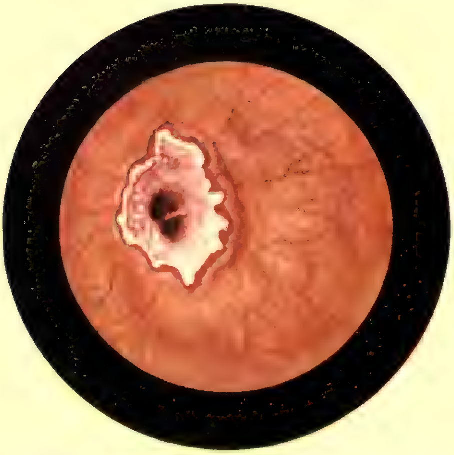

FIGURE E. Ulcer of the bladder with phosphatic deposit.

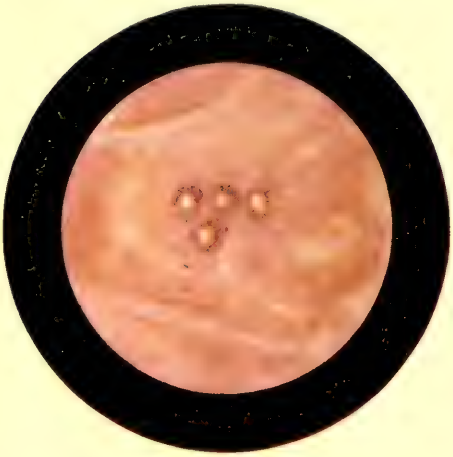

FIGURE F. Tubercles in the bladder mucous membrane.

of superficial ulceration may be present distributed principally over the ridges, and phosphatic deposit may take place on these denuded areas.

A number of special types of chronic cystitis are described.

(*a*) *Proliferative, papillary, vegetating, or pseudoneoplastic Cystitis.*—This form of inflammation affects especially the base of the bladder. The peculiar velvety appearance above described is more marked, and an appearance exactly resembling a sessile papillomatous growth is produced. This may be raised up into masses closely resembling a new growth.

(*b*) *Phosphatic Cystitis* (*Cystite incrustée*).—The deposit of phosphatic material in a necrosed surface in chronic cystitis has already been noted. There is, however, a form of cystitis in which the deposit of phosphates is the most striking feature. In a mild form phosphatic cystitis is met with in patients who have symptoms of cystitis, and pass from time to time large plugs of phosphates held together with mucus. Cystoscopy shows a considerable area at the base of the bladder, covered with heaped-up phosphates resembling a snow-drift. At the edge is seen a halo of cystitis, and the remainder of the bladder is healthy (Plate VII. Figure B).

In a severe form the whole bladder may be covered with masses of glistening white phosphatic material, heaped up in parts into hillocks. The underlying inflammation is of a comparatively mild type. In such a case I opened the bladder and sponged the interior with pure acetic acid, causing the rapid disappearance of the incrustation. The bladder was washed with a solution of acetic acid, and the condition was quickly cured.

(*c*) *Bullous Cystitis or Oedema Bullosum.*—This form of cystitis affects a part of the bladder-wall in some cases of chronic cystitis, and the area affected is usually at the base. It may disappear in a few days, or may persist for the duration of the cystitis. The affected area is covered with small glistening semi-transparent globules, with a brilliant light-reflecting surface, and closely packed together like the grains of caviare (Plate VII. Figure C). Occasionally the globules are heaped up into a prominent mass resembling a new growth. I have seen the prolapsed portion of a ureter covered with such bullae.

Bullous oedema is also found surrounding fistulae of the bladder (recto-vesical fistulae, etc.) and the mucous membrane surrounding malignant growths, and in the area of the bladder-wall overlying a perivesical abscess. Similar bullae may occasionally be observed surrounding the orifice of an inflamed ureter.

(*d*) *Cystic Cystitis.*—This is a peculiar form of cystitis in which transparent yellow cysts are scattered over the mucous membrane of the bladder. The cysts stand out clearly from the mucous membrane, and when seen in profile have a contracted base of attachment. Their distribution in irregular groups may be found, or the cysts may be sparsely scattered over the surface. The base is especially affected, but the cysts may be found high up on the posterior or lateral walls.

The mucous membrane is usually quite healthy, with the exception of a single or several fine vessels encircling the base of each cyst, and giving it a pink halo. These cysts have been shown to be due to blocking and distension of the mucous glands. Rokitansky described the condition under the name of 'herpes of the bladder,' and the cysts closely resemble the vesicles of herpes.

Cystic cystitis may be present with very little disturbance of the bladder-function, but occasionally there is great sensitiveness of the bladder, attacks of frequent micturition, and severe lancinating pain.

(*e*) *Granular Cystitis.*—In this form of cystitis there are myriads of fine yellowish nodules, which appear cystoscopically, the size of a pin's head. They are said to be due to leucocytic infiltration. The nodules closely resemble tubercle, but they are smaller and much more numerous than tubercle.

(*f*) *Leucoplakia.*—Occasionally a grey-white patch of leucoplakia is found in chronic cystitis. There is rarely more than one patch. The patch has the appearance of a thin wash-leather membrane, and careful examination will show that it is not a slough or mucopurulent deposit on a patch of ulceration.

Ulceration of the Bladder (non-tuberculous).—Two forms of non-tuberculous ulceration may be distinguished cystoscopically, namely a superficial and a deep.

1. *Superficial Ulceration.*—Superficial ulceration is comparatively common in cases of acute cystitis, and is frequently overlooked, owing to the fact that a considerable area of bladder-wall may be affected, and the outline of the ulceration is very irregular (Plate VII. Figure D). Along the crest of the ridges and folds of inflamed mucous membrane, in acute cystitis, patches of superficial ulceration are frequently observed. The ulcers are elongated and very irregular in form. The edge is marked by a thin ledge of frayed whitish epithelium, here and there elongated into a tag waving in the currents and eddies stirred up in the distending fluid by the movements of the cystoscope. The floor, only very slightly darker red in acute cystitis than the surrounding mucous membrane, but forming a pronounced contrast in less severe forms, is granular or woolly-looking, somewhat irregular, and very slightly depressed below the level of the mucous surface.

When the cystitis is subsiding, or has in part cleared up, the ulceration persists, and forms a more easily recognized and striking contrast to the paler mucous membrane. In patchy cystitis small, irregular, superficial ulcers may be observed.

A single ulcer may be present or a number. These may be grouped in a single area of the bladder, such as the apex or the posterior wall, or may be scattered over the mucous membrane. A clot may adhere to the ulcerated surface, or it may be produced with phosphates.

In acute or chronic general cystitis very extensive ulceration may be found, and is frequently overlooked.

The edge may border on slightly inflamed or almost normal mucous membrane and is marked by an irregular line of thin ragged epithelium. The area denuded of epithelium is red, granular, or woolly, and having no light-reflecting power, is dull-looking.

2. *Deep ulcers* may be multiple or single, irregular or round. The fact that an ulcer of the bladder is single does not, in my view, distinguish it as a pathological entity, although such has been described under the name of simple or solitary ulcer of the bladder.

Multiple ulcers may be present in the bladder at one period, and the number be reduced to one ulcer at a later period. An acute cystitis may resolve and leave an ulcer, with the surrounding mucous membrane healthy. A widespread superficial ulceration may heal, but leave a deeper ulcer at one point.

Non-tuberculous deep ulceration of the bladder is observed in a fair number of cases. The ulcer may be single or multiple, and is usually found on the base or posterior wall. In the cases which have come under my observation the appearance of the ulcer has varied with the acuteness of the cystitis and with the reaction of the urine..

In an acute, widespread cystitis is found a deep ulcer, irregular in shape, with a raised edge, the free margin of which is thin and ragged, with shreds of necrotic mucous membrane half detached. The floor is irregular, or even and granular. If the reaction of the urine is alkaline, phosphates form a white powder on the floor, or it may be thickly encrusted with phosphatic deposit (Plate VII. Figure E). An adherent clot may cover part of the floor. The infection here is usually mixed, strepto- and staphylococci being present with the *bacillus coli communis*. In other cases the acuteness of the cystitis has subsided, and one or several sharply-defined round ulcers are found. The ulcer is round, with a raised, slightly overhanging edge, and an even granular floor. Immediately around the ulcer is a narrow zone of inflammation. The general surface of the bladder is either normal, or shows a very moderate degree of inflammation. The infection in such cases is a pure culture of the *bacillus coli communis*. In a single case I have observed a ring-like ulcer. The ulcer, when first seen, formed a small ring at the apex of the bladder. In the centre of the ring the mucous membrane was normal. The narrow, trench-like ulcer was covered with greyish slough. Under observation for some weeks, this ulcer spread peripherally and healed in the centre, leaving a larger and larger central area of normal mucous membrane. A portion of the ulcer was excised by suprapubic cystotomy, and the remainder touched with solid nitrate of silver. This part of the ulcer continued to spread, and eventually reached the base, where it gradually healed after some years, leaving a single deep irregular ulcer in the neighbourhood of the trigone. This was excised, and the bladder eventually healed. The infection was a pure culture of the *bacillus coli communis*.

Tuberculosis of the Bladder.—The capacity of the bladder may be little, or not at all, diminished, and with care the full distension of 8 or 10 oz. may be obtained. In most cases, however, the capacity is diminished, and in some advanced cases the viscus will hold only 1, or at most 2 oz. Haemorrhage is rarely severe, but a slight oozing may be started by incautious distension of the bladder or by unskilled manipulation of the cystoscope, which is very difficult or impossible to control and which renders the medium too opaque for accurate observation.

A general anaesthetic is sometimes necessary on account of the extreme sensitiveness of the bladder. Over-distension of the tuberculous bladder under general anaesthesia gives rise to hurried respiration and eventually restlessness, and then the bladder becomes spasmodic and uncontrollable. The temperature of the distending fluid is carefully tested, and the distension carried out slowly and carefully, desisting when the pressure is felt to rise against the piston of the syringe.

The lesions found in a tuberculous bladder vary very greatly. (1) In a large number of cases, the lesions are those of acute or subacute cystitis, and show nothing that can be looked upon as characteristic of tuberculosis. (2) Lesions characteristic of tuberculosis are present. These consist of tubercles of the mucous membrane and ulceration.

1. *Tubercles* are found in a fair proportion of cases (Plate VII. Figure F). They may lie in the neighbourhood, or actually on the lip of one ureter; they may be scattered irregularly over an area of the bladder-wall, or they may occur in groups. In a few cases, miliary tuberculosis of the bladder occurs, the tubercles being scattered over the whole surface of the mucous membrane. A tubercle appears as a yellow nodule about the size of a pin's head. On careful inspection it looks as if it were being pushed up through the mucous membrane. Around it the mucous membrane shows a zone of inflammation, and when the tubercles are grouped, the group lies in a patch of inflammation; and a number of such patches

PLATE VIII. Vol. III.

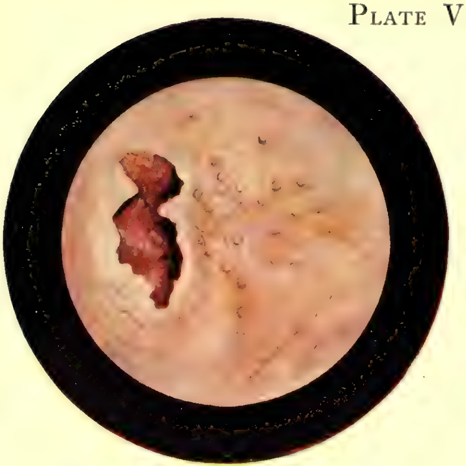

FIGURE A. Deep tuberculous ulceration.

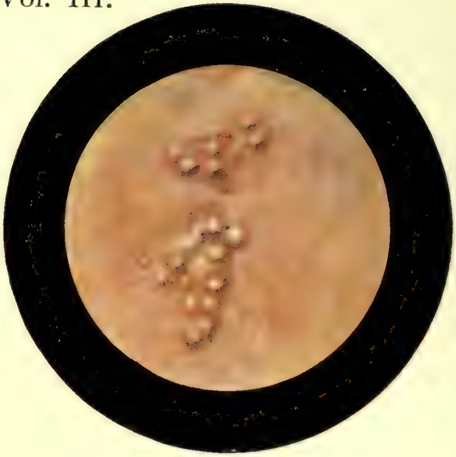

FIGURE B. Bilharziosis of the bladder.

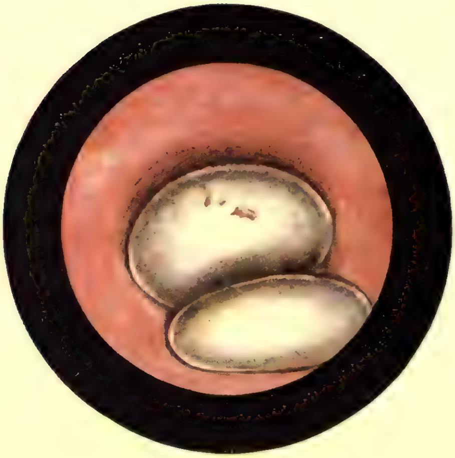

FIGURE C. Uric acid calculi.

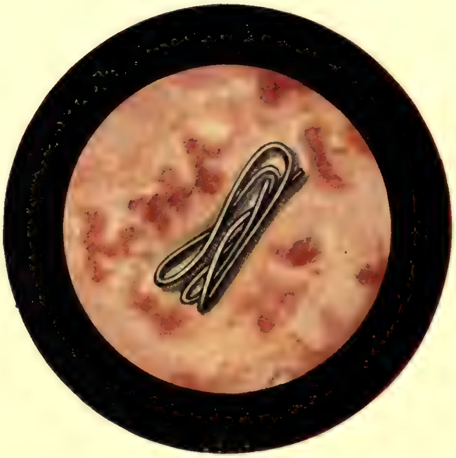

FIGURE D. Coiled hairpin in the bladder.

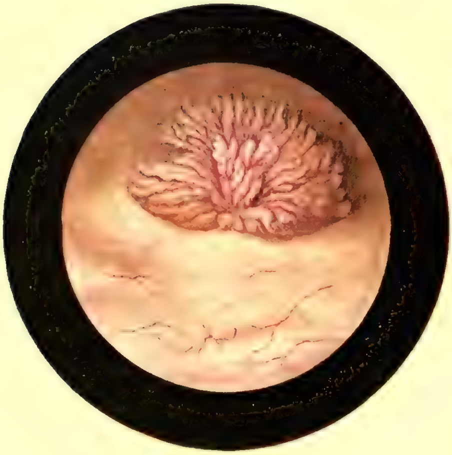

FIGURE E. Papilloma of the bladder.

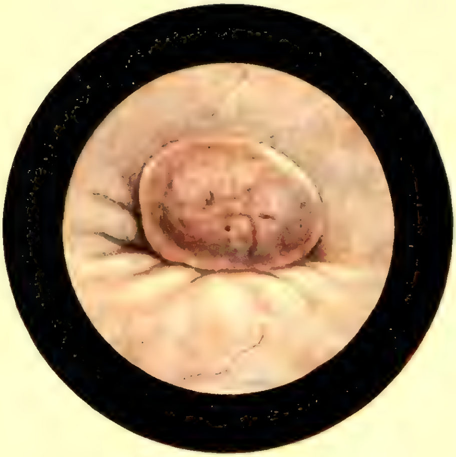

FIGURE F. Nodular malignant growth.

may be found. In one or two cases I have observed a solitary yellow tubercle of the size of a split pea; in one case umbilicated at the centre, with little or no surrounding inflammation.

2. *Tuberculous Ulceration.*—Tuberculous ulceration is superficial or deep. Widespread superficial ulceration, indistinguishable from that due to other infection, has already been noted. Small superficial ulcers, the size of a split pea, or larger ulcers the size of a threepenny- or sixpenny-piece, are not infrequently observed. The outline of the ulcers is irregular, and the surface may be partly covered with a yellowish slough. The mucous membrane immediately surrounding the ulcer is acutely inflamed, and there may be tubercles grouped around it. Radiating lines of puckered mucous membrane, produced by contraction of the base of the ulcer as it heals, are very frequently seen, and are characteristic of tubercle.

Deep tuberculous ulceration is less frequently found, but is occasionally met with in very chronic cases. The ulcer is irregular in outline, and variable in extent. The edge is undermined, and the margin of the mucous membrane thin and ragged. The floor is granular. At some part of the circumference the edge is shelving, and healing is evidently taking place. At another part an inflammatory blush shows that the process is extending. The mucous membrane surrounding the ulcer is usually little if at all inflamed; yellow tubercles may be grouped in the neighbourhood (Plate VIII. Figure A).

Where the ulceration is extensive it has a serpiginous outline. The occurrence of secondary infection obliterates the characteristic appearances of tuberculous ulceration, but the serpiginous outline may still be distinguished.

Bilharziosis.—Bilharziosis is caused by a trematode worm named the Bilharzia haematobia, and is prevalent in Egypt and South Africa. It occurs also on the east and west coasts of Africa. The male and female worms occupy the portal vein and descend to the veins of the rectum and bladder. There the female deposits eggs, which penetrate the mucous membrane, are shed, and appear in the urine and faeces. The lesions in the bladder consist of yellow tubercles and papillomatous masses. The tubercles form groups, with a small amount of secondary inflammation. The individual tubercles are larger and more prominent than those of tuberculosis of the bladder (Plate VIII. Figure B). There is a tendency to form ridges of mucous membrane on which groups of tubercles are set.

Papilloma-like masses are found. Those that I have seen were formed of masses of granulation tissue heaped up, and with bilharzial tubercles scattered over the surface. They did not resemble, either in cystoscopic appearance or on microscopic section, true papilloma of the bladder.

In severe cases sepsis becomes superadded, and widespread sloughing and ulceration of the epithelium and granulation tissue takes place. Phosphatic deposit follows and calculi are frequently found. In such cases cystoscopy is usually impossible, owing to the contraction of the bladder.

Calculus and Foreign Bodies in the Bladder

The diagnosis of stone in the bladder can frequently be made without the cystoscope. There are, on the other hand, many cases where the use of the cystoscope is indispensable; and in all cases useful information is obtained in regard to the bladder, preparatory to operation, and in regard to the ureteric orifices as an aid to prognosis.

Two other methods are used in the diagnosis of stone in the bladder, namely sounding and radiography. With the sound a large number of bladder-stones can be detected in the female. In the male, however, an enlargement of the prostate may prevent the sound reaching the stone, and stones in diverticula, or impacted in the lower end of the ureter are inaccessible to the sound. Moreover, small stones are easily missed by the sound; encrusted ulcers may be regarded as calculi, and the information in regard to the condition of the bladder, and the number and position of calculi, which is given by the cystoscope, cannot be obtained by the sound.

In cases of acute cystitis with stone, or in rare cases where the medium is persistently clouded by blood or pus, the stone-sound judiciously used may diagnose a stone when the cystoscope has failed.

Great irritability of the bladder may render cystoscopy difficult, or occasionally impossible. Haemorrhage and a medium loaded with pus and shreds are other difficulties that may be encountered. A large calculus may be pushed in front of the beak, and does not present in the field of the cystoscope, or it may be poised on the tip of the instrument, out of view. In such cases the contact of the cystoscope with the stone is felt distinctly, as if a sound were used, and a little manœuvring will bring the stone into view.

A calculus may be lodged in a diverticulum and may project from the mouth or it may present just inside the orifice. Usually, however, a calculus in a diverticulum is hidden from view inside the diverticulum. A calculus may be thickly coated with muco-pus, so that no part of its surface can be seen, and it forms an irregular, shaggy mass in an acutely inflamed and contracted bladder. As a rule, in such cases, the percussion of the cystoscope against the stone will have given a hint as to the character of the mass, and repeated and careful washing will uncover some part of the surface of the calculus, and enable a certain diagnosis to be made. Should this fail the sound and radiography must be tried.

A new growth of the bladder may be coated with phosphates, and closely resemble a stone. The situation of the phosphate-covered mass in some position—such as on a ridge or on the lateral or posterior wall—may raise a suspicion that the phosphatic mass is a growth, and not a calculus ; and careful examination after frequent washing may reveal some portion of the growth projecting through the phosphatic covering. The effect of movement of the patient laterally, and of raising the pelvis, may also assist ; the great majority of stones being freely movable. Finally, the mass should be probed with the end of a ureteric catheter which will dimple a growth, but meets with a hard resisting surface in the case of a stone.

A calculus which is free in the bladder changes its position with the position of the patient when the bladder contains fluid. This is easily demonstrated by means of the X-rays by turning the patient from side to side, or elevating the pelvis and obtaining a radiograph after each movement. In the cystoscopic position, the calculus lies on the base of the bladder behind the trigone, which is the lowest part of the cavity. Changes in position of the calculus may be demonstrated by rolling the patient over on one or other side. The size, number, and nature of the calculi may be seen by the cystoscope.

Only a part of the circumference of a large calculus can be seen, but from this, and by moving the cystoscope about and depressing the ocular end of the cystoscope so as to draw the window as far as possible away from the stone, an idea of the total size can be obtained. When there is a collection of fair-sized calculi in the bladder they form a heap, and only those lying on the surface can be seen and counted. Such collections are found, especially in male subjects with enlarged prostate, and the actual number is unimportant as it does not influence the question of operation.

The nature of the calculus can be frequently recognized. The oxalate of lime calculus has a characteristic mulberry shape, with projecting spikes : the typical uric acid calculus is a flat oval, with granular surface (Plate VIII. Figure c), while the phosphatic calculus is round, with granular, and sometimes irregular surface. The calcium oxalate stone is dark brown or black, the uric acid red brown or fawn, and the phosphatic greyish-white or snowy-white. Any calculus may be coated with phosphates, and the characteristic appearance and shape may be concealed by a phosphatic covering.

Multiple calculi, many hundreds in number, may be found. They are small, varying from a pin's head to a pea in size. There are usually one or two larger calculi present. Such calculi are usually composed of oxalate of lime or uric acid. Multiple phosphatic calculi are larger, and are faceted.

Cystoscopy is an important aid to operation on calculus. The presence of an enlarged prostate in the male, or the presence of extensive sacculation of the bladder, or of a calculus of very large size, or a calculus impacted in the lower end of the ureter or encysted in a diverticulum, will lead to removal of the stone by cystotomy, rather than by litholopaxy. The bladder should be examined with the cystoscope a week after litholopaxy to ascertain if all the fragments have been removed.

A foreign body in the bladder, such as a needle, hairpin, or drainage tube, is readily recognized in the early stage of its residence in the bladder (Plate VIII. Figure D). After some months the body becomes encrusted with phosphatic deposit, so that no part of it may be visible. As a rule, however, careful examination will reveal some uncovered part, and in any case the peculiar elongated shape of the phosphatic calculus will lead to a suspicion as to the nature of the body. The X-rays may give valuable assistance.

Tumours of the Bladder

The use of the cystoscope is indispensable in the diagnosis of tumours of the bladder. The majority of simple growths of the bladder present the solitary symptom haematuria, and neither physical examination nor the examination of the urine gives sufficiently definite evidence to show whether the haematuria originates in the bladder or in the kidney. In such cases the cystoscope differentiates between bladder- and kidney-haemorrhage, indicates which kidney is affected, if the haemorrhage is renal, and completes the diagnosis of the condition present if it originates from the bladder. Cystoscopy here supersedes the old method of exploratory operation, which not infrequently necessitated several operations on different parts of the urinary tract before the diagnosis was fully established.

The cystoscope is also invaluable as an aid to prognosis, by distinguishing the simple growth from the malignant. Further, the selection of cases suitable for operation is made by the cystoscope, and the extent and method of operation planned on the information obtained by means of a cystoscopic examination.

Some difficulties occur in cystoscopy in bladder-growths. On introducing the cystoscope, after washing and distension of the bladder, the window of the cystoscope may be shrouded in darkness, and after repeated efforts an occasional red glare is seen, but no view of the interior of the bladder is obtained. The tumour is so voluminous that the beak of the cystoscope, with the lamp and window, is buried in its folds. In such a case some hint may already have been obtained as to the size of the growth by the hesitating or interrupted flow of the washing-fluid through the irrigating tube of the cystoscope, and by the difficulty of manœuvring the cystoscope in the bladder.

Haemorrhage is practically always present, although it may have ceased at the time of the examination. It may be so severe as to render the cystoscopy extremely difficult. When the growth is situated at the internal meatus, severe and temporarily uncontrollable haemorrhage may follow the introduction of the cystoscope. There may be a slight continuous oozing, sufficient to render the medium cloudy, and prevent accurate inspection. These forms of haematuria are not infrequently the result of clumsy manipulation of the cystoscope within the bladder, or of too great or too rapid distension.

The use of a continuous stream of hot saline solution, or very weak nitrate of silver (1 in 10,000) through a double-way catheter which is inserted along the irrigation tube of the cystoscope, is usually effective in controlling bleeding. In persistent bleeding which is uncontrollable, it may be necessary to distend the bladder with air instead of fluid, in order to obtain an unclouded view of the growth.

Cystitis and bladder-spasm may create difficulty in the cystoscopy of bladder-growths. This is treated in the manner described under cystitis. If the cystitis is spontaneous, that is to say if it does not follow the passage of instruments, the growth is practically always malignant. Simple papilloma is usually found in an otherwise healthy bladder.

1. Primary Tumours of the Bladder.—The commonest varieties of tumour in the bladder are papilloma or villous growth, and malignant growths. The position of papilloma of the bladder in regard to malignancy is at the present time uncertain. These tumours possess certain characters, such as a pronounced tendency to recurrence, and the appearance and irregularity of cell-growth, that are also possessed by malignant growths. And further, after being present for long periods, the growth in a certain number of cases infiltrates the submucous tissues, invades the lymphatics, and forms metastases. When the cases come under observation for cystoscopy, the growths may be looked upon as innocent, but potentially malignant. I have been accustomed to regard papilloma of the bladder as a precancerous condition.

There is a form of malignant growth of the bladder which has a papillomatous structure, and is described under the name of malignant papilloma.

Papilloma or Villous Growth.—This is the commonest growth of the bladder. It occurs most frequently in young adults, but may be met with in old age. It is very rare in young children. The principal symptom is intermittent haematuria, occurring at first at long intervals, sometimes a year or more, but the attacks gradually increasing in frequency. Other symptoms are usually absent. There may, however, be increased frequency of micturition, or signs of obstruction of the bladder when the growth lies near the internal meatus, or pain in a kidney when it lies at the orifice of one ureter.

A papilloma usually presents a clear and very striking cystoscopic picture. The most frequent form resembles in outline a well-formed, coarse bath-sponge. It varies from a pale pink, scarcely distinguishable from the surrounding mucous membrane, to a deep red. On close examination the surface is made up of villi or finger-like processes, closely set and varying in length. Each villus has a central vessel which is readily seen, the villus being translucent in the bright light of the electric lamp. The ends of the villi are clubbed or knob-like, and here the central vessel forms a loop. The villi vary greatly in length. They may be nearly equal in length and closely packed, or they may be long and free, moving with every current of the surrounding fluid. Occasionally a single process, or several long processes, like the fronds of a fern or an ostrich feather, project from the surface, and wave in the fluid. Some papillomata have closely packed, leaf-like villi. If the urine becomes alkaline the villi may be powdered with white phosphatic deposit, and if infection has occurred, a few villi may be greyish-white, or the whole growth is covered with necrotic villi (Plate VIII. Figure E, p. 153).

Three varieties of attachment to the mucous membrane are found. The base may be pedunculated, contracted, or sessile. Most frequently there is a contracted base. The villi overlap the base all round, and the attachment may be quite small. It may be round or elongated. In a large growth it is frequently quite narrow, but may be one or two inches in length. The contracted base is short, so that the growth adheres closely to the surface of the mucous membrane. The pedunculated growth is attached to the mucous membrane by a slender pedicle of varying length, which permits a considerable range of movement, so that a pedunculated papilloma attached in the neighbourhood of the ureteric orifice may plug the internal meatus, and cause retention of urine.

A variety of pedunculated papilloma has a thick fleshy stalk. A small growth with a pedicle of this nature stands up like a hyacinth. The pedicle is firm and rigid to the touch, and gives the impression that there may be infiltration. These growths are not, however, malignant.

Sessile papillomata carpet the mucous membrane, without the formation of a pedicle. This form of growth is usually found with multiple papillomata, with contracted bases. It may be the first stage of recurrence of papilloma after removal by operation. Cystoscopically, the sessile type is readily recognized as a low growth spreading over an area of the mucous membrane. The extent and form of a contracted base may be ascertained by probing it with a ureteric catheter, and pushing the catheter laterally underneath it. A long pedicle may be completely hidden on cystoscopy, by the growth falling in front of the pedicle. A considerable change in position of the growth, on subsequent cystoscopic examination, raises the suspicion that the growth possesses a long pedicle, although it may be hidden from view. By forcibly injecting fluid through a ureteric catheter during inspection of the growth, it may be driven to one side by the current, and the extent of movement demonstrated.

The general surface of the mucous membrane, apart from the growth, is normal. Large veins lead up to the base of the tumour, and if it is situated at the bladder-base the vessels are usually derived from the trigone.

Papillomata vary greatly in size. They may be the size of a split pea, or even less, when first discovered, or a single large papilloma may be as large as an orange, and fill the whole bladder. The growths may be single or multiple. In the early stage, when the patient first comes under observation, they are single in the majority of cases. If left untreated, they usually become multiple, and recurrence after operation is frequently in the form of multiple growths. One large papilloma may be surrounded by smaller growths, or an area of mucous membrane may be closely covered with a group of papillomata the size of a pea, or larger. In such cases some part of the surface is usually covered with sessile papilloma.

Papillomata situated at points of contact on the postero-superior wall and base are sometimes observed, as if implantation had taken place. The area of the bladder most frequently affected is the base. The favourite seat of a solitary papilloma is just to the outer side, and behind the ureteric orifice, almost on the edge of the orifice. The base around the trigone is very frequently affected ; the surface of the trigone rather less so. Papillomata grow from the edge of the internal meatus. They are especially frequent in this position when there are multiple papillomata of the bladder. They may extend a short distance along the mucous membrane of the urethra. The middle zone of the bladder is less frequently affected, and the upper zone or apex still less often. When there are multiple papillomata, any part of the bladder-wall may be affected. The anterior wall is not infrequently the seat of an extensive papillomatous growth.

Malignant Growths.—These present a variety of cystoscopic appearances which correspond in some degree to their microscopical structure. Malignant papilloma may resemble very closely the cystoscopic appearance of simple papilloma. In the great majority of cases, however, the appearance is sufficiently distinctive to leave no doubt as to the malignant nature of the growth. The growth is sessile, although it may have a contracted base, and rarely possesses a pedicle. The villi are stunted, irregular, and very closely packed, so that the surface has a smooth, raspberry-like appearance. Signs of infiltration of the bladder-wall may be observed in the surrounding mucous membrane. The pedicle, if one be present, is thick and fleshy, and the mucous membrane at its base is ridged and puckered, and may have a thickened velvety appearance. Oedematous tags may project from the mucous membrane, and occasionally a separate nodule of growth in the mucous membrane may be seen. These growths may be solitary, but as a rule they are multiple. Some of the growths having this appearance have the microscopic characters of a benign papilloma, while one or more have the appearances described above.

Nodular Sessile or Pedunculated Growths.—These growths vary in size from a large pea to a Tangerine orange. The surface is smooth, and may be finely or coarsely nodular, opaque, and pink or yellowish pink in colour (Plate VIII. Figure F, p. 153). The surrounding mucous membrane may show signs of infiltration. The centre of the growth is sometimes depressed, and, adherent to it, is a hard brown-black or grey mass formed by a mixture of blood-clot and phosphates. Part, or the whole of the surface may be necrotic, and has the appearance of shreddy masses of asbestos.

These tumours belong to the papillomatous group. The surface consists of a dense mass of irregular villi closely welded together, and sometimes necrotic on the surface, at the centre. In the deeper part there is a fine stroma of fibrous tissue supporting irregular spaces filled with cells, frequently arranged in papillary formation. Masses of cells infiltrate the muscular planes, passing along the lymphatic vessels.

Infiltrating Growths.—The growth forms flat nodules on the surface of the mucous membrane, with evidence of infiltration (Plate IX. Figure F, p. 165). The mucous membrane of the whole of the affected area shows the appearance of acute cystitis. Not infrequently the growth takes the form of a depressed ulcerated area, surrounded by nodules, or by a raised, hard ring of growths.

The histological structure varies. It may have the form of a squamous epithelioma with well-developed cell-nests, an alveolar carcinoma, or, rarely, a cylindrical epithelioma or adenocarcinoma. The condition of the unaffected portion of the mucous membrane varies in different cases. It is frequently quite normal in malignant papilloma and in nodular growths, but in a large proportion of cases, and almost invariably in the infiltrating variety, general cystitis is present when the case comes under observation.

Cystoscopic Diagnosis.—To the experienced cystoscopist the diagnosis of a growth of the bladder is doubtful in only the most exceptional cases, but to the novice there are many difficulties, and mistakes are frequently made; usually in the direction of regarding other pathological conditions as new growths.

(1) A mass of blood-clot or fibrin projecting from a ureter, or lying on the base of the bladder may be mistaken for a growth, but in reality does not at all resemble one. It forms a dark mass of a brown, or brown and grey colour, which is quite opaque, with a dull, unreflecting surface. The surface may be smooth or ragged, and if the base can be seen it is evidently lying upon, and not incorporated with the mucous membrane. The mistake once rectified is not likely to be repeated.

(2) A stone covered with shreds of mucus may resemble a necrotic growth, but its free movement and more careful inspection will reveal its nature. The beak of the cystoscope not infrequently clicks against the stone, and gives a hint, if the diagnosis has not already been made.

(3) Round the internal meatus in the female bladder finger-like tags of mucous membrane are not infrequently observed, and may be mistaken by the novice for new growths. A growth originating outside the bladder and pressing upon it, an abscess in the perivesical tissues (*e.g.* perivesical abscess), and the irritation of a fistula between the bowel and the bladder, give rise to changes in the bladder mucous membrane that closely resemble a growth. The surface is covered with rounded, closely-packed, finger-like processes, which may form a circumscribed mass, readily mistaken for growths. The processes, with good illumination, are translucent. They are larger and more regular than the nodules of a growth, and with care will be recognized as a circumscribed bullous cystitis. The secondary circumstances, such as high temperature or the presence of faecal matter in the urine, assist in making a diagnosis.

(4) A form of cystitis occurs with heaping up of the mucous membrane, or of granulation with considerable masses (proliferative cystitis), which are difficult to distinguish from new growth. In some cases the inflamed mucous membrane has a velvety granular appearance which closely resembles a sessile papilloma : in others, ridges and nodules are formed, resembling a nodular growth.

Examination of the whole bladder will show that these appearances form part of a general cystitis, and on subsequent examinations the deceptive appearances may have so changed that no difficulty in diagnosis is experienced.

(5) Prolapse of the ureters produces a prominent tumour in the bladder that may be mistaken for a new growth. I have had two cases referred to me by surgeons who had made this mistake on cystoscopy. The prolapsed portion of the ureter is attached in the position of the normal ureteric orifice. Careful observation will

show that the swelling is cystic, and that it becomes distended very slowly, and then slowly diminishes in size. The changes resemble on a small scale the very slow inflation and deflation of a toy rubber balloon. The orifice of the ureter may be seen on the surface of the balloon, and it is sometimes possible to insert the point of a ureteric catheter into it.

2. Secondary New Growths.—The bladder may be affected by a portion of a papillomatous tumour of the pelvis of the kidney becoming detached and implanted at the orifice of the ureter.

The most frequent form of secondary new growth in the female subject is a direct spread through the bladder-wall of malignant growth of the cervix uteri. Growths from the ovaries and from the bowel may also invade the bladder. Before the growth penetrates the mucous membrane the surface becomes covered with bullous cystitis, which may closely resemble a growth. When the growth has penetrated the mucous membrane there is widespread cystitis, and the surface is thrown into irregular folds. Nodules of growth are seen and there may be an area of greyish-yellow necrosis. The situation of the extensive growth on the base involving the trigone makes it difficult to obtain a good view, and the ocular end of the cystoscope must be well depressed, so as to raise the prism and light away from the growth. Vaginal examination confirms the diagnosis. In a few cases that have come under my notice the bladder-symptoms were prominent, and those pointing to a cervical growth were insignificant.

Pre-Operative Cystoscopy.—Apart from the diagnosis of a new growth of the bladder, the cystoscope has an important *rôle* in indicating the cases suitable for operation, and the nature and extent of the operation.

The points in diagnosis between simple and malignant growths have already been discussed. In examining a case of papilloma of the bladder with a view to treatment the selection of cases suitable for fulguration, and those in which suprapubic cystotomy should be performed, is the first consideration. A solitary papilloma of moderate size, in the base of the bladder, is most suitable for fulguration. Any part of the bladder is, however, accessible with the high-frequency cautery, the anterior wall, anterior part of the lateral walls, and the extreme apex, being the most difficult to reach. A fringe of papilloma round the internal meatus is awkwardly situated, and may be inaccessible by this method of treatment.

Multiple papillomata, if small, are suitable for fulguration, but if large, should be treated by open operation.

All other papillomata should be treated by suprapubic cystotomy. As a preliminary to operation, a chart of the bladder should be made, and each growth noted on it, so that none is overlooked at the operation.

In malignant growth of the bladder the position and extent are the most important points in deciding whether an operation is advisable, and its extent. The most favourable position for radical operation is the apex and upper zone of the bladder. As the lower part of the bladder is approached, the position becomes less and less favourable. When the growth lies in the neighbourhood of the trigone transplantation of the ureter may have to be performed, as part of the operation. Where the trigone is encroached on, and where the urethral orifice is invaded, the position is unfavourable for radical operation.

The second important point in the examination is the extent of the growth. Only the intravesical extent of the growth can be estimated, and it must be remembered that when the growth has penetrated as far as the muscular layer, it spreads laterally with great rapidity, owing to the rich and freely anastomosing lymphatic plexus. This part of the growth, and the perivesical spread, cannot be estimated by the cystoscope, and is only defined by the finger, after opening the bladder.

Very large malignant growths are not suitable for resection of the bladder. A growth having an intravesical area of a half-crown piece, is, in general terms, the limit of size that may be removed with a view to cure by resection of the bladder-wall.

Cystoscopic Examination of the Ureteric Orifices

On each lateral horn of the trigone, at the part of the bar of Mercier which passes out to become lost on the base of the bladder, lies the orifice of the ureter. The orifices are about one inch apart, and lie about the same distance from the internal meatus.

Method of finding the Ureteric Orifices.—In many cases the cystoscope may be placed in position with the ureteric orifice in the field of the prism without looking along the telescope of the cystoscope. The cystoscope is introduced with the prism facing upwards, and its axis lies in the middle line of the body. Keeping the axis in this line, the instrument is rotated so that the window looks directly downwards, and lies over the centre of the bar of Mercier. It is now turned to one side, one-sixth of a turn, and the outer part of the bar of Mercier with the ureteric orifice lies in the field of view (Plate IX. Figure A).

The most certain method of finding the orifice is to turn the prism downwards in the middle line, and recognize the interureteric bar or base of the trigone. This is followed outwards to one or other side, and becomes more prominent as it narrows. On the narrow portion is found the ureteric orifice. It is recognized as a small fine slit or a round depression. If it is not evident at the first glance a blood-vessel which is almost invariably present will lead to it. This vessel issues from the orifice, or immediately alongside it, and passes backwards and outwards, branching almost immediately, or emerging as a double vessel. The ureteric orifice will be found at the point at which it makes its appearance. The orifice is usually seen without difficulty, but it may be almost invisible when closed although quite evident when gaping. A watch should therefore be kept on the position at which it is supposed to be, and this will be rewarded by seeing it open, and a jet of urine escape.

There may be difficulty in finding the second ureter when one has already been discovered. In such a case the prism should be turned back to the orifice which has already been examined, and, keeping the axis of the cystoscope exactly in the middle line of the body, it is rotated slowly towards the side of the missing ureter, following with the eye the line of the interureteric bar. The position at which the second orifice should appear will be known by bearing in mind the degree of rotation required to display the first ureter on the other side. Failure to discover one ureter should not, unless the observation be made by an experienced cystoscopist, be accepted as proof that it does not exist, and that the kidney is absent on that side.

An aid to discovery of the ureteric orifice, which may be useful in difficult cases, is named ‘ chromocystoscopy.’ An injection of 10 c.c. of a 4 per cent solution of indigo-carmine is made into the muscles of the thigh or buttock. In from twenty minutes to half an hour the urine is coloured a dark blue. The bladder is washed and filled with clear medium, and the position of the ureteric orifice examined. A cloud of dark blue fluid fogs the view for a few seconds, and as it diffuses the deep blue tail of the efflux is seen oozing quietly from the orifice.

A ureteric catheter in a catheterizing cystoscope may assist the search for a ureter by probing any likely depressions in the normal position of the orifice.

The trigone-muscle is usually deficient or wanting on the side on which the ureter is absent. The ureteric orifice which is apparently absent may be displaced. In the female the orifice may be situated in the wall of the urethra. Such cases are rare. The presence of a ureteric orifice in normal position is not conclusive evidence that a patent ureter and functional kidney are present. A depression or a hollow tube several centimetres in length may exist where the remainder of the ureter and the kidney are congenitally absent. A double ureteric orifice on one side, with normal orifice on the other side, is found in about 4 per cent of cases. The second orifice may be merely a depression, but it is usually the opening of a second ureter

Plate IX. Vol. III.

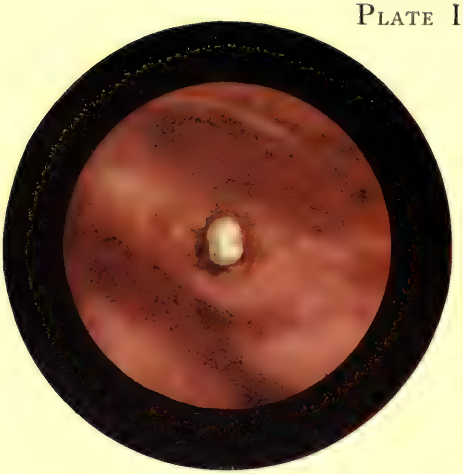

Figure A. Ureteric orifice with a bead of semi-solid pus issuing therefrom.

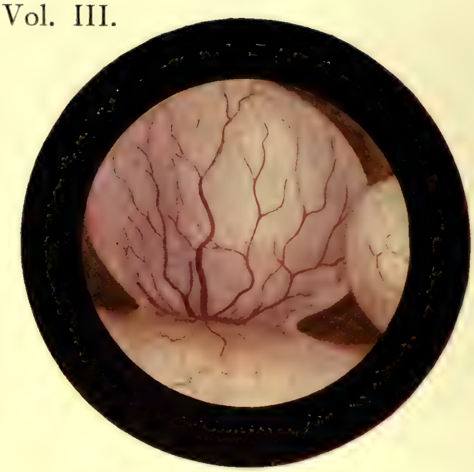

Figure B. Prolapse of the ureter.

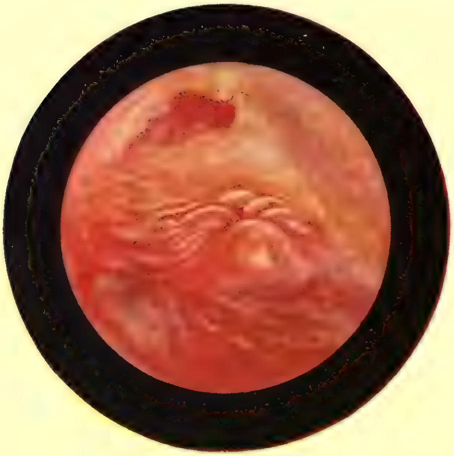

Figure C. Ureteric orifice in acute ureteritis.

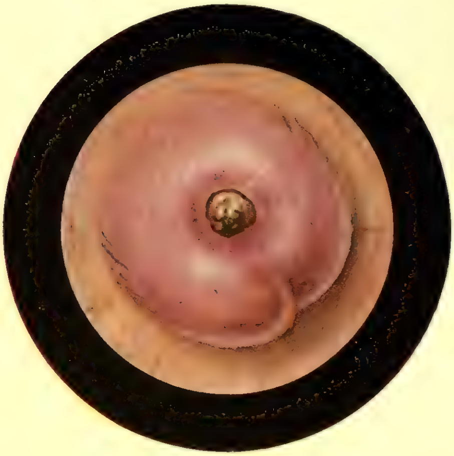

Figure D. Calculus projecting from ureteric orifice.

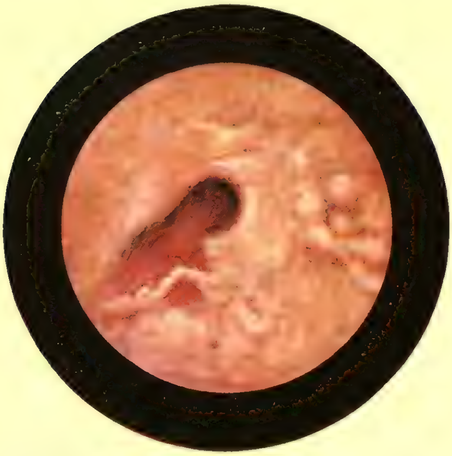

Figure E. Dragged-out tuberculous ureteric orifice.

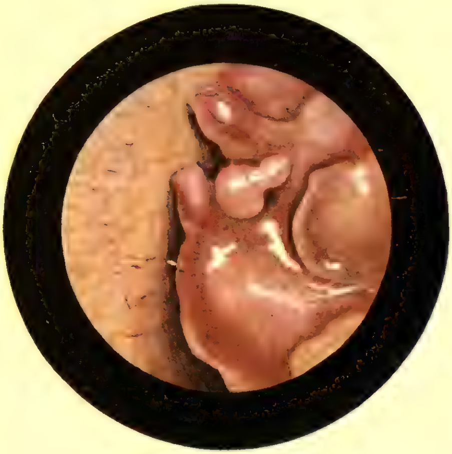

Figure F. An infiltrating growth of the bladder.

on this side. The presence of a double ureter can be demonstrated by passing an opaque bougie up each ureter, and obtaining an X-ray photograph. A double renal pelvis is also present, and the two parts of the kidney, although apparently fused, are physiologically separate organs. One part may be the seat of advanced disease, while the other is quite free.

The ureteric orifices are occasionally so small that the finest ureteric catheter will not pass. This congenital narrowing may be present without other abnormality. Cystic dilatation, or prolapse of the lower end of the ureter, occurs when the ureteric orifice is ballooned by the pressure of the urine (Plate IX. Figure B). The size of the cyst varies greatly. It may be quite small and only observed during the wave of contraction of the ureter, or it may be observed in a more advanced form where the cyst is permanently present, but the amount of distension varies. A peculiar and striking picture is produced which is very frequently mistaken for a growth. There should, however, be no difficulty in recognizing the nature of the swelling. One or both sides may be affected. A globular swelling is found in the position of the ureteric orifice. This is constricted at its base, and branching blood-vessels are traced on its surface. At some part, usually at the pole farthest from the attached base, the orifice of the ureter may be seen. This may, however, be invisible. Under observation the balloon is seen slowly to expand and become more translucent and globular; then it slowly contracts, and becomes more opaque and conical. After a short interval the process of expansion and contraction is repeated. The appearance and movements are unmistakable. In a case under my care, one of the cysts was covered with a bullous oedema, and resembled a large red raspberry.

A collection of small calculi may be found in the cyst. In one of my cases a single large calculus filled the prolapsed portion of the ureter, and could be seen appearing at the orifice, on the pole of the swelling. Dilatation of the ureteric orifice is found in rare cases without obstruction in the bladder or urethra. The orifice is large, oval, and permanently open. Both sides have been affected in the few cases I have seen.

Pyelitis and Ureteritis.—In almost all cases of pyelitis, changes may be observed at the ureteric orifice. When the pyelitis is severe, and the inflammation has extended to the bladder, the appearance of the ureteric orifice is characteristic. In slight pyelitis the ureteric orifice is round, and tends to remain open and rigid, and there is a pink blush of inflammation surrounding it. The contraction of the ureter is vigorous, and has the appearance of a spasm. In acute pyelitis and ureteritis the ureteric orifice is surrounded by warped and wrinkled bright red mucous membrane. The folds radiate from the ureteric orifice, but the actual opening may be so buried as to be hidden from view. Bright red patches of haemorrhage in the mucous membrane are frequently found in the neighbourhood. The contraction of the ureter is vigorous and spasmodic (Plate IX. Figure C).

Stone in the Renal Pelvis and Ureter.—The ureteric orifice may present a completely normal appearance. When infection has occurred, the changes described under pyelitis and ureteritis may be observed. After an attack of renal (ureteric) colic, splashes of haemorrhage into the otherwise normal mucous membrane in the vicinity of the ureteric orifice, are constantly observed. Frequently repeated, vigorous, spasmodic contractions of the ureter are sometimes noted, or the contraction may be slowly and lazily performed. In rare cases a ring of oedematous bullae surrounds the ureteric orifice, and massive oedematous folds may obliterate the outlines of the trigone (Plate IX. Figure D).

The nose of a calculus may project from the ureteric orifice, surrounded by an oedematous ring (Plate IX. Figure C). The calculus may be white, grey, dark brown, or black. Sometimes it is covered with large crystals which glisten in the light of the cystoscope lamp. The intramural portion of the ureter may be raised up into a mass which has a dark bluish appearance from the calculus shining through.

The ureteric orifice immediately after the passage of a calculus into the bladder is prolapsed, and resembles a mushroom. This rapidly subsides and in a few hours has disappeared. Laceration of the edge of the orifice, and an irregular shape, are changes frequently seen after the passage of a calculus. In a case under my observation a calculus sloughed into the bladder from the intramural portion of the ureter, leaving an irregular opening which, later, contracted, and left a gaping, oval opening, through which the urine was discharged above and outside the normal orifice of the ureter.

The Ureteric Orifice in Tuberculosis of the Kidney and Ureter.—In the earliest stages of renal tuberculosis, no change may be detected at the orifice of the ureter. The earliest appearance may be a slight reddening around the orifice of the ureter, and a little thickening of one of the lips. Not infrequently a solitary tubercle is found on the lip of the ureter, and others may be found dotted in the vicinity. The edge of the orifice may be ragged and ulcerated. In a more advanced stage the ureteric orifice is surrounded by ulceration, and the opening may be lost in the irregular, granular, ulcerated surface.

Oedema of the ureteric orifice is a frequent and almost characteristic change in tuberculosis of the kidney. The surrounding mucous membrane of the bladder may be quite healthy, and the ureteric orifice is buried in a rosette of oedematous bullae. In a late stage of chronic tuberculosis of the kidney, the ureter is thickened and shortened, and the ureteric orifice is dragged outwards and backwards (Plate IX. Figure E).

On following the interureteric bar it is found to be thick and prominent, and leads to a tunnel in which it disappears. The orifice of the ureter is in the depth of this pit or tunnel which is an inch and a half or more, outside and behind the normal position.

Occasionally the ridge of the interureteric bar glides out and in of this tunnel like a piston. The lumen of the ureter in such cases is frequently blocked with caseous material, but it may be patent and admit a ureteric catheter as far as the renal pelvis.

Movements at the Ureteric Orifice.—The movement which takes place at the ureteric orifice represents the end of a wave of contraction which has passed down the ureter from the renal pelvis. The contraction is initiated by stimulation of the renal pelvis. This is sufficient to produce a wave that will travel along the ureter, and reach the bladder, but by the time it reaches the lower end of the ureter, the contraction is very feeble. If, for instance, the ureter be completely blocked at its upper end, the contractions initiated in the distended renal pelvis are still seen with the cystoscope at the lower end of the ureter, but they are leisurely and wanting in vigour.

A similar phenomenon is observed where a fistula of the ureter drains away the whole of the urine, but the continuity of the ureter has not been completely interrupted. The passage of the urine along the ureter acts as a stimulus to further contraction, and produces a vigorous wave along the whole length of the ureter. The effect of local stimulation of the ureter may be observed when the tube is exposed at operation. A gentle squeeze with forceps will produce a writhing vermicular movement in the ureter. With the cystoscope, the movements commence in the ridge beyond the ureteric orifice, which swells up. The swelling rolls along the ridge, and surrounds the orifice. Each lip of the orifice now contracts and shortens, and the orifice gapes. A jet of urine escapes, and the movement subsides, the lips relax, and the orifice closes. When the urine is clear, the jet which issues from the ureteric orifice is recognized by the swirl produced: not unlike the appearance produced by dropping glycerine into water.

The ureters contract alternately; the swirl of the urine from one ureter can frequently be seen crossing the field when the other orifice is under observation. The number of times the contraction at the ureteric orifice is repeated, varies greatly. In the healthy subject, contraction takes place about once in 20 or 25 seconds. This is, however, liable to very considerable variations depending upon the quantity of fluid passing down the ureter, and partly upon the irritating qualities of the fluid, or upon the presence of an irritant in the ureter. Thus, in polyuria from disease, or artificially produced, the contractions are frequent, and the volume of the efflux is copious. When the ureter is inflamed or has a stone impacted in its lumen, the contractions are frequent and powerful. On the other hand, when the lumen is completely blocked or is closed, hydronephrosis due to kinks or calculus at the outlet of the renal pelvis, the contractions are feeble and occur at long intervals, and the efflux is absent or may be reduced to a trickle.

The ureteric orifice may remain passive for two or even four minutes during examination either under local or general anaesthesia. This may result from the effect of the heat or light of the lamp, or it may be a reflex phenomenon from the presence of an instrument in the urethra.

Catheterization of the Ureters

The catheterization cystoscope and ureteral catheters have already been described. The method of preparation, and the technique of cystoscopy differ in no way from those of ordinary cystoscopic examination.

Catheterization of the ureters can be carried out in the great majority of cases, without a general and even without local anaesthesia. It is advisable to give the patient a draught of plain, or Contrexéville, water half an hour before commencing the anaesthetic, and, should the secretion be poorly performed in spite of this, rectal administration of saline solution should be used.

I use a single-barrel catheterizing cystoscope, and it is seldom that the calibre of the female urethra is too small to permit the passage of this. A double-barrel cystoscope which carries two catheters, is a much larger instrument, and may fail to pass the external meatus. Should this difficulty occur, a small pledget of cotton wool soaked in novocaine (2 per cent) or cocaine (1 per cent) should be pushed into the meatus with a pair of sinus forceps, and in a few minutes a graduated metal instrument, or a series of these, is passed, and the cystoscope will easily follow. A distension of 10 or 12 oz. should be aimed at, as it is an advantage in inserting the catheter to have the trigone sunk a little lower than the line of the urethra. The ureters can, however, be catheterized by an experienced cystoscopist with a very small distension : 2 oz. occasionally sufficing.

After filling the bladder through the irrigating portion of the cystoscope, the telescope is introduced, and the ureteral catheter then pushed along the catheter-tunnel until the end lies just within the field of the window. In order to accomplish this, the stop-cock at the end of the catheter-tunnel is opened, and the catheter pushed through the open end of the tunnel. Some fluid from the bladder may escape alongside the catheter. This is controlled by screwing up the screw-cap at the tunnel end, and thus tightening the grip of a perforated washer which surrounds the catheter here. The window is now turned downwards, and the interureteric ridge is brought into view. By turning the cystoscope on its axis, to one or other side, the ridge is followed outwards, and the ureteric orifice comes into view.

The method of finding the ureters has already been described. The axis of the cystoscope is in the middle line of the body, and the instrument is rotated about one-sixth of a circle to one side. The ocular end of the cystoscope is now carried a little towards the opposite thigh, so that the window approaches the orifice. Some manœuvring may be necessary in order to approach closely the orifice. Until this has been accomplished no movement of the catheter, or of the catheter-elevator, should be made.

The window of the cystoscope is now close to the orifice, and the catheter is gently pushed outwards until the point is in the centre of the field. By lowering the beak the point of the catheter may engage in the ureteric orifice. As a rule, however, elevation is necessary. This is accomplished by turning the screw at the ocular end of the cystoscope, so that the elevator is raised, and the point of the catheter projected away from the axis of the cystoscope towards the bladder-wall. The catheter is now pushed gently outwards, passing from within outwards, and engages in the ureteric orifice. The cystoscope is held firmly in position, and the catheter pushed slowly outwards. As it disappears within the ureteric orifice the half-inches, inches, and 6-inch marks are noted. When the 12-inch mark (double red band) is seen, the surgeon knows that the point of the catheter has passed into the renal pelvis, and enters the upper calyx of this kidney. The catheter is withdrawn ½ or 1 inch, and kept in this position for drainage of the pelvis.

If it is intended to catheterize both ureters, and a double-barrel cystoscope is being used, the window of the cystoscope is turned to the opposite ureteric orifice, and the catheterization repeated on this side. The elevator is now lowered, the cystoscope turned beak upwards, after carefully noting which is the right and which is the left ureter, the light switched out, and the cystoscope gently withdrawn, pushing the catheters into the tunnel as the cystoscope comes out, and finally detaching them from the cystoscope.

If a single-barrel cystoscope is being used, after catheterizing the first ureter it is withdrawn, first having lowered the elevator and switched off the light. The cystoscope is now loaded with a second catheter, and reintroduced, and the second ureter is catheterized. Having accomplished this the elevator is lowered, and the light switched off. The telescope is now withdrawn, the bladder is emptied of fluid, and the telescope replaced before withdrawing the cystoscope. If the telescope is not reintroduced before removing the cystoscope, the catheter is apt to drop into the main tube from the catheter tunnel, as the latter has no floor and the catheter gets entangled ; so that in removing the cystoscope it is dragged from the ureter.

The catheters having been freed from the cystoscope, each is attached, by means of a piece of adhesive plaster, to the thigh on the side corresponding to the kidney which it drains. The end of the catheter is placed in a sterile bottle, the neck of which is plugged with sterilized wool. Should the catheter fail to drain, half a drachm of boracic lotion should be injected by means of the catheter-syringe, to ensure that the passage is clear.

I usually give the patient a large cup of hot tea to drink before, and another during the drainage of the kidneys.

The amount of urine which is collected depends upon the nature of the examination desired. Two or three drachms, or even less, will suffice for an ordinary bacteriological examination; an ounce, or preferably several ounces, should be collected for examination for tubercle, and several ounces are necessary for estimation of urea, or specific gravity. Having obtained a sufficient quantity of urine, the bottles are removed and corked, and the ureteric catheters are pulled straight out. The catheters are thoroughly washed in antiseptic solution, dried and oiled, and set aside. The patient is kept in bed for thirty-six or forty-eight hours, and given diuretics.

Difficulties in Catheterization of the Ureters.—The difficulties of ordinary cystoscopy, such as a spasmodic bladder, haemorrhage, purulent urine, difficulty in finding the ureteric orifices, etc., are doubly important when it is proposed to catheterize the ureters.

The ureteric orifice may be set on a hillock, or so placed on a ridge as to be difficult to reach with the catheter. Variation in the amount of distension of the bladder will usually overcome this. In rare cases the ureteric orifices are placed so near the urethral orifice that it is difficult or impossible to manœuvre the catheter into the proper axis, or to enter the lumen of the ureter. The catheter approaches the orifice at right angles to the line of the ureter.

The ureteric orifice may be so small that the catheter will not enter. There are very few ureters that a No. 4 catheter will not enter, but such are occasionally found.

After penetrating from a half to three-quarters of an inch, the catheter may be arrested. This is due to the change in direction of the ureter as it leaves the wall of the bladder, which is more marked in the female than in the male subject. By varying the distension of the bladder, shifting the position of the patient, injecting boracic lotion through the catheter by means of a small syringe, and by gently withdrawing and pushing on the catheter, the difficulty may be overcome. A different shape and a small size of catheter may pass. Finally, the attempt may have to be abandoned, and repeated in a few days.

Calculi in the duct (Plate IX. Figure D), tumours pressing on it or adhesions dragging it from without, arrest the passage of the catheter.

The presence of blood in the urine collected may be due to an abrasion of the lining membrane of the ureter, or to injury to a calyx by pushing the catheter too far.

Allusion has already been made to temporary arrest of the renal secretion during catheterization.

The Application of Catheterization of the Ureter.—The field of usefulness of catheterization of the ureter is a wide one. It is principally in diagnosis that the method is valuable, but it has also been found useful in the treatment of some forms of disease. The following are the principal uses of ureteral catheterization: (*a*) *Diagnosis*—(1) The presence and function of a kidney; (2) is the bladder or kidney affected? (3) which kidney is affected? (4) is the kidney dilated? (5) sounding the ureter; (6) indicating the course of the ureter. (*b*) *Treatment*—(1) Lavage of the renal pelvis; (2) injection of oil, etc., in descending renal calculus; (3) dilatation of stricture of the ureter. Some of these do not require any comment, and only the first named will be examined in detail.

The Presence and Function of a Kidney. — When it is proposed to operate on a kidney, and especially when the kidney may have to be removed, it is necessary to ascertain the presence of a second kidney, and to examine its function with the view to ascertain as far as possible if it can undertake the total renal function.

The discovery of a ureteric orifice on the side of the supposed healthy kidney is not an infallible proof that a kidney is present on this side, for the ureter may be patent for a short distance, and end in a fibrous cord, while the kidney is absent. The observation of an efflux for the ureteric orifice, however, is sufficient evidence, and this may be supplemented by the intramuscular injection of indigo-carmine (4 per cent) which will stain the urine deep blue, so that the coloured jet can easily be seen at the ureteric orifice. The presence of the second kidney, except in the very rare cases where two normal ureters arise from a single fused kidney, can be ascertained, and some idea of its function gained by inspection of the ureteric orifice, and chromocystoscopy.

More conclusive evidence of the value of the second kidney is, however, required, and in order to obtain this, catheterization of the ureter is necessary. A large number of methods of testing the renal function have been used, but only a few of the most practical need be mentioned here.

Estimation of Urea.—Where it is desired to estimate the function of one kidney, the urine secreted during a short period of one or two hours must suffice, since more prolonged catheterization as a routine measure is inadvisable.

The likelihood of fallacy is therefore greater here than in the examination of the whole urine of both kidneys. As a means of comparing the function of the two kidneys in a given time, however, the examination has some value.

The percentage of urea in the urine of the diseased kidney is reduced, and the difference between this and the quantity of the urine of the healthy kidney may amount to 1 per cent or even more. The following series of observations were made in a case of tuberculous disease of the right kidney:

Right Kidney (tuberculous). Urea.	Left Kidney (healthy). Urea.
0·9 per cent.	2·4 per cent.
1·1 ,,	2·4 ,,
1·0 ,,	2·6 ,,
0·8 ,,	2·5 ,,

Polyuria on the diseased side may still further diminish the urea-percentage. The following figures were obtained from a case of right calculous pyonephrosis:

Right Kidney (pyonephrosis).		Left Kidney (healthy).	
Urea.	Urine.	Urea.	Urine.
0·4 per cent.	206·5 c.c.	1·3 per cent.	107·5 c.c.

The actual quantity of urea eliminated in a given time should be estimated.

A normal kidney should secrete 1·2 to 1·8 grammes of urea in two hours. A moderate estimation in this time would be 0·75 grammes to 1·0 grammes, but the function is poor when the urea is reduced below 0·75 grammes.

A number of tests have been used in which a known quantity of colouring matter is injected into the muscles, or directly into the blood, and the quantity eliminated by the kidneys estimated, and taken as an index of the functional capacity of the kidneys. Methylene-blue, indigo-carmine, and phenol-sulphone-phthalein have been used for this purpose. The latter was introduced by Geraghty in 1910 [1] and has proved the most reliable of the colour tests. It will therefore be described.

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[1] *Trans. Amer. Assoc. Genito-Urinary Surgeons*, 1910, vol. v.

Phenol-sulphone-phthalein Test.—The patient drinks 400 c.c. of water, twenty minutes before the injection. One cubic centimetre of a solution containing 6 mg. of phenol-sulphone-phthalein is injected into the muscles of the thigh or buttock. If the total renal function is to be estimated the test is carried out as follows : The patient empties the bladder immediately before the test. One hour and ten minutes after the injection the bladder is emptied, and the urine set aside. The bladder is again emptied at the end of two hours and ten minutes after the injection, and the second sample kept. Each of the samples is now tested. It is placed in a one-litre measure, and water added to 200 c.c. and 10 c.c. of sodium hydrate solution (25 per cent) added, to render it alkaline. The urine assumes a brilliant purple-red colour. Distilled water is now added up to one litre, and the mixture shaken and filtered. A sample of this is placed in a Duboscq's calorimeter, and compared with a standard solution ($\frac{1}{2}$ c.c. of the injection fluid in a litre of water rendered alkaline by the addition of NaOH) placed in a graduated receptacle. The number of the scale to which the coloured urine corresponds is read off, and the percentage of the excreted colouring material obtained. In normal cases the colouring material appears in from five to ten minutes : 40 to 60 per cent of the drug is excreted in the first hour, 20 to 25 per cent in the second hour, and 60 to 80 per cent in the two hours.

When the functional activity of one kidney is to be examined, the ureters are catheterized, and the urine collected in separate bottles for two hours. The commencement of the elimination of the colouring matter is timed by allowing the urine to drop into test tubes containing sodium hydrate solution. When this has been noted, the urines are collected and tested at the end of the first and the second hours, as above. The drug is principally if not entirely eliminated by the tubules of the kidneys. The test is easily used, and is reliable.

It is impossible to lay down any rule as to the minimum percentage which may be safe for nephrectomy. The percentages usually obtained by the writer have been somewhat below those stated by the introducers of the method. I have successfully operated on a man with enlarged prostate when clinical symptoms of renal failure were present (thirst, headache, dry tongue, loss of appetite), and a preliminary cystotomy had been done some weeks previously. A good percentage excretion of phenol-phthalein was obtained, and prostatectomy was successfully carried out.

A fallacy that underlies the tests for the renal function is the fact that the actual secretory activity of the kidney at any one time is not necessarily the maximum secretory power of the organ. Beyond the ordinary secretory activity of the kidneys, there is, in the normal subject, a margin of safety which provides against sudden reduction of the secretory tissue. It is this margin of safety, this difference between potential and actual renal activity, that these methods of estimation of the renal function fail to show.

INFECTIONS OF THE URINARY TRACT

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PYELITIS AND PYELONEPHRITIS

LITERALLY, the term *pyelitis* means inflammation of the pelvis of the kidney alone; *pyelonephritis* means inflammation of both pelvis and kidney-substance. It is doubtful if the inflammation is ever as limited as the term pyelitis suggests, and it is more likely that all infections of the kidney represent different stages of the same condition. Inflammation of the kidney and pelvis may be due to bacterial infection, or may be caused by the excretion of irritants, or by mechanical means, such as acute retention of urine, or chronic obstruction to the urinary stream.

We are only interested in the infective variety of pyelonephritis, which occurs in two main forms: (1) haematogenous, (2) ascending.

The *B. coli communis* is the most common cause of renal infection; other organisms found are *Staphylococcus pyogenes aureus*, *B. tuberculosus*, and occasionally *Streptococcus*, *Staphylococcus albus*, *B. proteus*, and *Actinomyces*. Predisposing causes to renal infection are calculus, hydronephrosis, obstruction of the ureter, retention of urine, septicaemia, and cystitis.

Haematogenous Pyelonephritis

Haematogenous pyelonephritis is about as common as the ascending form. It is met with at all ages. In infants and young children it is quite common, and usually affects the pelvis more than the kidney. It is an important complication of pregnancy, and this condition will be described in detail later.

In haematogenous pyelonephritis men and women are affected equally. The right kidney is rather more commonly involved than the left. The bacteria usually have their origin in the large intestine, and a history of chronic constipation can often be obtained. It is well known that in healthy persons bacteria are constantly entering the lymphatics from the intestine. They may be destroyed in the lymphatic glands or may circulate in the blood-stream, and be excreted in the urine by the kidneys. Evidence tends to show that organisms can pass through the kidney without giving rise to any lesion ; this has been proved in the case of *B. tuberculosus* by Walsham [1] and Foulerton and Hillier,[2] therefore some predisposing factor is assumed to be present to produce pyelonephritis. The most probable factor is the toxaemia of chronic constipation associated with an exceptionally large number of organisms ; or the organisms themselves may be of unusual virulence.

Other predisposing causes, but less likely ones, are previous renal disease, calculus, the excretion of irritants, etc.

Symptoms.—It is usual to describe three types of acute haematogenous pyelonephritis.

1. *The Hyperacute or Fulminating Type.*—This is the most serious, and is so virulent as frequently to prove fatal before any definite renal symptoms have time to develop. The patient, previously in good health, has a severe rigor, and the temperature rises to 104° or 105° F. This is followed by drowsiness or even coma. The urine is scanty, and contains organisms, casts, and blood. There may be complete suppression of urine.

2. *The Acute Type.*—Under this heading the largest number of cases fall. There is a severe initial rigor, with a rise of temperature to 102° or 103° F. The patient is either prostrated or delirious. There are usually headache, nausea, and vomiting. The pain, at first general in the abdomen, later usually settles down in the right loin, and an attack of renal colic may occur. The abdominal muscles of the affected side are usually rigid, there is marked tenderness over the kidney in front, and in the costo-vertebral angle behind. If the muscles are not too rigid, the kidney can be made out to be enlarged.

The urine is scanty, and contains pus, red blood-cells, and casts. The urine from each kidney should be examined separately, and that from the second kidney may be normal.

After the attack has lasted two or three weeks the symptoms gradually subside, but relapses are not very uncommon. In some cases, when a certain amount of improvement has taken place, the condition becomes a chronic one.

3. *The Mild Type.*—In such cases the temperature rarely exceeds 101° F. with or without a rigor. There are frequency of micturition, some aching in the loins, and often tenderness on palpation of the kidney. The urine is pale and abundant,

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[1] *Lancet*, 1901, vol. ii. p. 311.

[2] *British Medical Journal*, 1901, vol. ii. p. 774.

contains pus and bacteria, occasionally red blood-cells. Cases of this type are frequently mistaken for subacute appendicitis. In a few days the temperature falls and the tenderness over the kidney disappears. In about a fortnight the urine has become clear, but bacilli may be present in it for a much longer period.

Chronic pyelonephritis is a common sequel of an acute attack, and may, from time to time, give rise to smart exacerbations with febrile disturbance. It is marked by frequency of micturition, usually more at night, and this is due to both cystitis and polyuria.

These cases are frequently mistaken for chronic cystitis, and have to be distinguished by a cystoscopic examination. In chronic pyelonephritis the ureteric orifice on the side of the diseased kidney is seen to be surrounded by an inflammatory zone, and the efflux from that ureter is abundant and clouded with pus. Large quantities of pale urine are secreted, often turbid, containing pus, and occasionally small shreds. Bacilluria may be present.

Diagnosis.—The *fulminating* cases have to be diagnosed from some acute general infection, such as infective endocarditis, acute influenza, the onset of lobar pneumonia. This can be done by an examination of the urine, which must include identification by culture of the bacteria present. *Acute* cases with abdominal signs have to be diagnosed from appendicitis, cholecystitis, and subphrenic abscess. If an enlarged tender kidney can be felt, this, combined with urinary changes, is diagnostic. In *chronic* cases, as mentioned above, the diagnosis from chronic cystitis is made by a cystoscopic examination ; a separate examination of the urine from each kidney obtained by ureteral catheterization will confirm it. A skiagram of the kidneys should be taken to exclude calculus.

Prognosis.—In *fulminating* cases the outlook is very grave, and a fatal result common. The only hope for the patient is an early diagnosis and immediate operation. In *acute* cases the prognosis, though still doubtful, is by no means so serious as in the fulminating cases. Where the disease is of a *mild* type recovery is usual. Recurrent attacks may occur, as already shown, and result in a chronic pyelonephritis. *Chronic pyelonephritis* may last for years, and tends eventually to destroy the kidney.

Treatment is carried out by the following methods : (1) medicinal, (2) vaccine and serum, (3) lavage, (4) operation.

Medicinal treatment consists in giving urinary antiseptics, and keeping the bowels open to prevent the further absorption of organisms from the intestines. The patient should be kept in bed with hot fomentations over the loin to relieve the pain. Copious draughts of warm water are very helpful, and urotropin or helmitol in

10-grain doses should be given every four hours. Potassium citrate in half-drachm doses three times a day is useful in some cases.

This is the best treatment for all the mild cases, and will sometimes be sufficient for acute ones in an early stage.

Vaccine and Serum Treatment.—Vaccine treatment consists in injecting measured quantities of dead bacteria obtained from cultures of the patient's urine ; this is known as an autogenous vaccine. If there is not time to prepare an autogenous one, a stock vaccine may be used. Small doses should be used at first, five million colon-bacilli or less. The dose should be repeated in a few days, and if it give rise to no reaction it should be steadily increased. In chronic cases vaccine treatment may have to be continued over a long period, even up to eighteen months, but it may be of great value, and result in a complete cure. In acute cases vaccine treatment is not of any value.

Serum treatment consists in injection of colon-bacillus serum, as most cases are due to infection with this organism. It is usual to begin with doses of 25 c.c. and repeat the dose twice at short intervals ; if no improvement results from three such doses it is useless to continue the treatment. Dudgeon[1] reports a series of 12 cases of acute pyelonephritis treated by serums. In 9 cases there was improvement, in 3 there was no alteration.

Lavage.—Kidd[2] claims that by washing out the bladder and renal pelvis practically all cases can be cured. He uses a solution of silver nitrate (gr. 5 to 1 oz. of water) for washing out the bladder, and for the renal pelvis 5 per cent collargol solution, through a ureteral catheter.

Operative Treatment.—The operations that have been performed include nephrotomy, decapsulation, draining abscesses, partial nephrectomy, and nephrectomy.

Brewer[3] considers that nephrectomy is the only method of treatment in the acute fulminating type, and this alone gives the patient a chance of recovery. The results obtained by nephrotomy are always bad in this type of the disease. Nephrectomy may be resorted to in very chronic pyelonephritis, either when the renal function is lost in the affected kidney, or for recurrent acute attacks, or for persistent cystitis. Nephrotomy usually gives unsatisfactory results, and the mortality following it is much higher than after nephrectomy.

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[1] *Lancet*, 1908, t. 616.

[2] XVIIth International Congress of Medicine, London 1913.

[3] *Ibid.*

Ascending Pyelonephritis (Septic Pyelonephritis).

This condition results from a spread of infection from the lower urinary tract. It may follow surgical operations on the bladder and instrumental examination of the bladder and urethra. It is also a terminal phase of such conditions as malignant disease of the bladder, vesical calculus, and (in men) of stricture of the urethra and enlarged prostate. For this reason the misleading title of *surgical kidney* is often applied to the disease.

Sampson[1] considers that bacteria may reach the kidney from the bladder by the following routes :

(1) Blood-vessels.
    (*a*) General circulation.
    (*b*) Anastomosis between renal, ovarian, uterine, and vesical vessels.
    (*c*) Vessels of the ureter.
(2) Lymphatics of the ureter.
(3) Ureteral mucous membrane.

Infection *via* the ureter is the most common. It spreads either by direct continuity of the inflammatory process or by the ascent of motile organisms.

The presence of organisms in the bladder is by no means regularly followed by ascending infection of the kidneys. This is due to the fact that reflux of urine from the bladder is prevented by the valvular insertion of the ureter into that organ. The downward stream of urine is a further protection against the ascent of organisms.

Ascending pyelonephritis may be unilateral in the early stage, but it invariably becomes bilateral, though one side may be more affected than the other. Over 75 per cent of all cases are bilateral in the initial stages.

This disease may arise in an acute or chronic form.

Acute Ascending Pyelonephritis.—This variety arises in the course of some chronic disease of the lower urinary passage, usually as a direct result of surgical treatment. The symptoms come on suddenly, within a few hours of the surgical interference, beginning either with a rigor and a rise of temperature to 103° or 104°, or the temperature may be subnormal throughout the attack. The patient is usually drowsy, and complains of backache, which may be more marked on one side. The skin, mouth, and tongue are dry, there is intense thirst. Nausea and vomiting are frequently present, associated often with obstinate constipation. Hiccough, when it occurs, is severe enough to distress the patient. The abdomen becomes distended, generally accompanied by rigidity of the abdominal muscles.

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[1] *Johns Hopkins Hospital Bulletin*, 1903, vol. cliii. p. 334.

The progress of the case varies. In the very severe cases the temperature either remains high, or falls, to rise again with another rigor, continuing high and swinging, the patient becomes increasingly drowsy, the vomiting more frequent, and hiccough constant. The urine is suppressed. Convulsions are very rare. Delirium develops, passing into coma, in which the patient dies. In the less severe cases the flow of urine becomes re-established, the temperature falls, and the symptoms subside. In mild cases the temperature rarely rises above 102°, the amount of urine is diminished, and the patient has malaise, is constipated, and has more or less headache, nausea, and vomiting. The urine contains pus, becomes offensive, and may contain blood.

Chronic Ascending Pyelonephritis.—This variety usually follows an acute attack, but may also be superadded to chronic haematogenous pyelonephritis (p. 177). The onset, in the latter event, is always so gradual that it may be difficult to say when the septic element appeared. The patient has a sallow colour and the skin is dry. The tongue is at first dry, and later becomes glazed, red, and cracked. Loss of appetite, nausea, constipation, and continual loss of weight are characteristic. Headache, drowsiness, and subnormal temperature are also present. There is polyuria, the urine containing a small amount of albumen, pus, and bacilli. The kidney-function is considerably diminished, as seen by the delay in excretion of methylene-blue after injection, and by the failure to excrete sugar after an injection of phloridzin.

The course of chronic ascending pyelonephritis may be interrupted by acute attacks, brought on usually by instrumental interference, or by a chill, or by over-exertion. During these attacks the patient's condition resembles that already described in the acute form. Death has occurred sometimes during attacks of this kind. Except when these exacerbations occur, the patient goes gradually downhill. In the later stages of the disease the amount of urine is diminished, and headache, thirst, drowsiness, and other symptoms increase ; uraemic convulsions are very rare.

Diagnosis.—The occurrence of acute symptoms after instrumental examination in a case of disease of the lower urinary passages makes the diagnosis obvious. If the urine becomes clear and the temperature remains high and swinging and the kidney enlarged, it usually means that a pyonephrosis has developed. It is important to recognize the occurrence of ascending pyelonephritis in cases of bladder-disease or *carcinoma cervicis uteri* ; the symptoms are slight and their onset insidious.

Examination of the urine is essential, and tests of the renal function must be carried out. If operative treatment is proposed both ureters must be catheterized and the urine separately examined.

Prognosis.—Many patients die during the acute attack of ascending pyelonephritis, and those who recover usually develop chronic pyelonephritis. Removal of the urinary obstruction stops further progress of the disease, but the kidneys are usually permanently damaged

Treatment of Acute Ascending Pyelonephritis.—Prophylactic measures consist in the sterilization of all instruments, of basins, syringes, lotions, careful cleansing of patient and the surgeon's hands. Care in using the instruments is important, so that no bruising or laceration of the tissues takes place.

General measures take the form of counter-irritation to the loin to relieve renal congestion, of dry cupping, hot fomentations, stupes, poultices, etc. A hot pack should be used to produce sweating. Pilocarpine may be used, but with great care. It is important to keep the bowels open, and to relieve the abdominal distension. Castor oil or saline purges are the best, but as vomiting is a common symptom it may prevent any dose being given by mouth. Soap and water, turpentine and rue enemata, or the rectal tube are useful to bring away flatus. If the patient can swallow, copious draughts of warm water and diuretin (gr. 10) should be given every four hours. Subcutaneous infusion of glucose in saline can be given in large quantities up to several pints, or the glucose can be given intravenously.

Operative Treatment.—Should the initial symptoms be very severe, or should the above treatment have proved useless, after two or three days' time operative measures will be necessary, and they are undertaken (1) to overcome the urinary obstruction, (2) to relieve congestion of the kidney, and to drain it.

The operation which is performed for the urinary obstruction is not necessarily the same as that which would be performed if the renal complication had not arisen. The usual method is to drain the bladder by a suprapubic cystotomy. This is only a temporary measure. To relieve the renal congestion, nephrotomy is performed. The kidney is incised freely along its convex border, and a drainage tube passed into the renal pelvis. The space around the kidney is also drained. Improvement usually follows this operation in a very few hours, being marked by a fall of temperature, and free secretion of urine. Nephrectomy causes more shock, and is a more prolonged operation; it is therefore not indicated in these cases, as speed is a very important factor—also the second kidney is usually more or less affected by the disease, and will not be improved by removing its fellow on the opposite side.

Treatment of Chronic Ascending Pyelonephritis.—Prophylactic treatment consists in removing the cause of the urinary obstruction as early as possible to prevent this condition arising. When chronic pyelonephritis is present, operative interference of all types on the lower urinary passages must be embarked upon only with the greatest caution.

Nephrotomy and nephrectomy are not indicated in this condition owing to the bilateral nature of the disease. An attempt should be made to flush out the kidneys by administration of large quantities of bland fluids, after draining the bladder by cystotomy.

Pyelonephritis of Pregnancy

Of the serious complications of pregnancy, pyelonephritis is one of the most important. In the vast majority of cases the patients affected have had no symptoms of previous renal trouble, and are quite healthy until, during the course of their pregnancy, they are attacked by this disease. In a few very rare cases women suffering from pyelonephritis become pregnant, and an exacerbation of the renal symptoms occurs; this is very infrequent, and is not usually included in the term *pyelonephritis of pregnancy*.

Pathology.—In considering the pathology of this condition, it is noted that previous to the pregnancy there has been nothing pointing to renal trouble; therefore the enlarging uterus has been, and is, regarded as an important factor in the production of the lesions found. In some cases that have been operated upon, and others that have come to the *post-mortem* room, it has been undoubtedly shown that dilatation of the ureter, above the pelvic brim, is present; Russell Andrews[1] quotes 68 cases of dilatation of the ureter out of 196 examined by these means. This dilatation is ascribed to the pressure of the growing uterus. It may here be remarked that the condition is a unilateral one in three-fourths of the cases, and when one kidney alone is attacked the right side is affected three or four times as often as the left. Legueu[2] found the right kidney affected in 65 out of 70 cases. This selection of the right side is explained by the fact that the uterine inclination, when present, is always to the right; besides this the uterus may rotate on its vertical axis and then turn towards the side to which it inclines. These factors result in greater pressure on the right ureter than on the left. Mirabeau[3] holds that the dilatation of the ureters is due to the congestion of the vesical mucous membrane which causes obstruction to the urinary flow; if his view were correct one would expect to find both kidneys equally attacked.

Bacteriology.—*B. coli communis* is the organism found in nearly all the cases—Albeck[4] found *B. coli* in pure culture in 76 cases out of 92 examined during pregnancy. Other organisms which have been found in rare instances are

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[1] *British Medical Journal*, 1912, vol. i. p. 1112.

[2] *Ann. d. mal. d. org. génito-urin.*, 1904, p. 1441.

[3] *Archiv f. Gyn.* Bd. lxxxvi. S. 485.

[4] *Zeitschr. f. Geb. u. Gyn.*, 1907, vol. lx.

Staphylococcus aureus, *Streptococcus pyogenes*, and *B. proteus*. These organisms may be present alone, or with *B. coli* in a mixed infection.

The route by which the infection reaches the kidney is still in dispute. The three possibilities are ascent from the bladder, invasion by the blood-stream, and the migration of organisms through the wall of the ascending colon into its immediate neighbour, the pelvis of the right kidney (Mirabeau). Of these three possibilities, the first two are considered the more likely, but there are two powerful arguments against the ascending path, viz. that in this disease there are usually no symptoms of cystitis, and again, that cystoscopy reveals a healthy bladder in almost every case.

Bearing in mind these facts, the haematogenous is undoubtedly the most likely type of infection; and it may be noted that organisms, such as *B. tuberculosus* and *B. typhosus*, reach the kidney by the blood-stream, and are excreted in the urine. It is well established that *B. coli* frequently enters the blood-stream from the intestinal canal, particularly if there is any abnormality of function of the alimentary tract, *e.g.* chronic constipation. The healthy kidney will eliminate these organisms without sustaining any damage, while the kidney, in which resistance has been lowered by obstruction to the urinary flow, has not the power to withstand them.

The changes met with in the kidney itself are as follows: The organ is enlarged, tense, and deeply congested. On section the renal substance is seen to be dark, and markedly engorged, the inflammatory change extending outwards even into the cortex. French[1] has described a case in which the kidney-substance contained multiple abscesses. The author has seen a case in which a large hydronephrosis had resulted, and Hicks[2] describes one in which there was a pyonephrosis.

From the above, one can deduce the sequence of events which leads up to an attack of pyelonephritis of pregnancy—enlargement of the uterus, pressure on the ureter at the pelvic brim, dilatation of the ureter and renal pelvis with urine containing *B. coli*, and subsequent infection of the kidney.

Symptoms.—The onset of the disease is most commonly about the fifth month of pregnancy, and it is seen with equal frequency in primigravidae and multigravidae. Recurrence in subsequent pregnancies does occur, but is unusual.

The initial symptoms vary considerably in their severity and mode of onset. Cases can be roughly grouped into two classes—acute and mild. In the latter group there is usually some dull aching pain on movement in the lumbar region. There are no signs of constitutional disturbance, and many cases of this type pass without recognition, which is only possible by examination of a catheter-specimen of the urine. The acute cases begin with marked suddenness, often with an initial rigor. The patient is obviously ill, the temperature high and swinging, and pulse-rate raised. Severe pain is present in one loin, and in the lower abdomen ; this pain is sometimes paroxysmal in character, and associated with frequent and painful micturition. Palpation of the kidney is rendered difficult by the presence of the pregnant uterus, and may be completely prevented by muscular rigidity. When the kidney can be felt it is usually enlarged and tender.

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[1] *British Medical Journal*, 1908, vol. l. p. 1034.
[2] *British Journal Obst. and Gyn.*, 1918, vol. i. p. 308.

The urine is acid, pale in colour, and a whitish deposit appears on standing. Microscopic examination of the deposit reveals the presence of pus, bacilli, hyaline and granular casts, and rarely blood. The amount of pus in any case may vary considerably from time to time, and occasionally, even when the disease is at its height, it is absent from the urine owing to temporary blocking of the ureter on the affected side. Bacteriological examination results in the discovery of *B. coli communis.*

Diagnosis.—Cases which present bladder-symptoms seldom pass unrecognized, as they at once direct attention to the urinary system. But, unfortunately, in the majority of acute cases the ureter and kidney only are first attacked, and the source of the mischief is therefore less obvious.

Intraperitoneal causes of infection, such as acute appendicitis, acute intestinal obstruction, and acute cholecystitis, are liable to be mistaken for the acute type. Pneumonia, pleurisy, renal and ureteric calculus are diagnoses that one has seen. This disease can sometimes be diagnosed by microscopic and bacteriological examination of the urine only, but, as remarked above, pyuria may be absent at times, and then urinary examination will not be sufficient. The diagnosis can always be made by cystoscopy and by separate examination of the urines obtained by catheterization of the ureters.

Course and Prognosis.—If untreated, about 25 per cent of cases end spontaneously in premature labour. The disease has no dangerous effect on the child other than the debilitating effect of premature birth. In the puerperium there is usually some febrile disturbance due to the pyelonephritis, but this improves quite quickly. There is no increased risk of puerperal sepsis. The renal condition usually clears up soon after the pregnancy has ended, but occasionally bacilluria persists and exacerbations occur in subsequent pregnancies.

Treatment.—Prophylaxis may be carried out by treatment of constipation during pregnancy.

There is no doubt that the treatment of pyelonephritis of pregnancy should be as conservative as possible. The general treatment consists of rest in bed, milk diet, plenty of bland drinks, and mild purgation; violent purgatives should be avoided lest they bring on labour. Drug-treatment consists in giving urinary antiseptics, urotropin or helmitol (gr. 10 of each) which should be combined with an acid salt such as acid sodium phosphate (gr. xxx), as these drugs are effective in acid urine only. Vaccine treatment should be tried: the results are more satisfactory in chronic cases than in acute ones, and autogenous vaccines give better results than stock vaccines; Rovsing[1] claims very good results by vaccine treatment.

The pain may be treated by hot applications over the kidney; but it may be so severe as to require morphia. Considerable relief can sometimes be obtained by raising the foot of the bed about 2 feet, which causes the action of gravity to release the pressure on the pelvic brim. Catheterization of the ureters by draining the renal pelvis gives excellent results, and lavage of the renal pelvis can be carried out through the ureteric catheters.

Interruption of pregnancy should be avoided, if possible, and expectant treatment should be given a good trial. It may, however, be necessary in a severe case, or when the condition is bilateral and does not yield to medical treatment.

Surgical treatment is rarely necessary in pyelonephritis of pregnancy, and can usually be avoided by emptying the uterus. When necessary nephrotomy is the usual operation, and it may enable the patient to go to full term. After the operation of nephrotomy, the urinary fistula rarely closes until after the termination of the pregnancy. Nephrectomy is never performed in pyelonephritis of pregnancy.

Pyelonephritis of the Puerperium.—Pyelonephritis during the puerperium usually makes its appearance at the end of the first week. It may arise in patients who have had no symptoms of renal trouble during pregnancy, or in those who have pyelonephritis during their pregnancy, but have been cured before the onset of labour.

The disease usually begins acutely, with pain and tenderness in one or other loin, and with a high intermittent temperature, often accompanied by rigors. The urine is acid, contains pus, and yields on cultivation a pure growth of *B. coli communis.* The condition is not a dangerous one, and with proper treatment rapidly disappears; if the condition is not recognized, it drags on, with febrile disturbance and an occasional rigor, for ten days to a fortnight, tending slowly to improve. Pyrexia associated with rigors during the puerperium is always serious, and pyelonephritis is liable to be mistaken for septicaemia, appendicitis, or salpingitis. The diagnosis can always be made by urinary and cystoscopic examinations.

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[1] *Hospitalstidende*, Copenhagen, 1909, vol. lii. p. 19.

The *treatment* consists in giving large drinks of non-irritating fluids. Urotropin should be given in 10- to 20-grain doses, and may well be combined with sodium acid phosphate gr. 30. In cases which resist medicinal treatment a good result can be obtained by preparing an autogenous vaccine from the patient's urine.

Perinephritis and Perinephric Abscess

Perinephritis. — This condition is usually described in three forms—fibrous, fibro-fatty, and suppurative. The first two forms are the result of chronic inflammation which has never reached the suppurative stage. The kidney is invariably diseased in these forms, such chronic conditions as pyelonephritis, pyonephrosis, calculus, and tuberculosis being present.

In the fibrous form the perirenal fat disappears as such and is transformed into dense fibrous tissue of an almost cartilaginous hardness, which is adherent to all surrounding structures. In the commoner fibro-fatty form, the perirenal fat is replaced by tough fibrous tissue with fat-globules scattered in the meshes. This fibro-fatty mass is very adherent to surrounding structures, and to the kidney-capsule. In both these conditions, when removing the kidney it is usually necessary to do an intracapsular nephrectomy.

The *symptoms* are usually slight, and masked by the symptoms of the renal disease which causes the perinephritis. Treatment should be directed against the cause—in other words, the underlying renal diseases.

Perinephric Abscess. — A perinephric abscess may be primary or secondary. It occurs at any age, but is more common in adult-life. It does not occur so frequently in women as in men, and is situated more often on the right side than the left.

The primary form may follow injury of the kidney and infection of the resulting haematoma—it may also arise in the course of an acute fever, such as typhoid, scarlet fever, smallpox, or pneumonia.

The secondary form results from suppuration in some neighbouring organ, *e.g.* kidney, liver, or gall-bladder, or from a duodenal ulcer. Pus from an empyema or abscess of the lung occasionally tracks through the diaphragm, and gives rise to a perinephric abscess. A tuberculous perinephric abscess is rarely due to tuberculosis of the kidney, usually to tuberculosis of the ribs or vertebrae.

The following organisms are found: *B. coli communis*, streptococci, and staphylococci—rarely gonococcus and *B. tuberculosis*.

Pathology.—The abscess is usually unilocular, and is always situated outside the fibrous capsule of the kidney. The abscess is found in four positions in relation to the kidney.

(1) Behind the kidney is the most common. In this position it may burrow through the muscles and point in the triangle of Petit.

(2) In front of the kidney, and limited anteriorly by peritoneum. The abscess rarely ruptures into the peritoneal cavity, but more frequently into the bowel.

(3) Above the kidney. This abscess is subphrenic and often communicates with some intrathoracic suppuration.

(4) Below the kidney. From this position pus tends to track into the iliac fossa, and then along the psoas muscle, pointing in Scarpa's triangle; or it may escape from the pelvis through the great sacro-sciatic foramen, pointing in the ischiorectal fossa.

Symptoms.—The symptoms vary in their onset and course; usually they are at first insidious and not well marked, occasionally they begin suddenly with a rigor.

In the more usual type of case the general condition of the patient is bad, and there is fever of a remittent type, temperature 102° to 103° F. at night but normal in the morning. In very chronic cases large abscesses are found when there has been no rise of temperature whatever. The amount of pain is variable. At first it is slight, and often merely a dull aching in the loin. It may be severe and paroxysmal, radiating down the leg, to the shoulder and arm, or to the vulva. It is intensified by movement. There is increasing tenderness in the loin, and the abdominal muscles of the affected side become rigid.

The patient sometimes complains of stiffness and limitation of movement of the corresponding thigh—due to contraction of the psoas muscle. Later a tumour forms in the loin, bulging outwards and backwards; this does not move with respiration. It is rare to be able to obtain fluctuation through it. Finally, the overlying skin becomes oedematous.

Some variations of the symptoms are found according to the position of the abscess. In the variety above the kidney, in addition to symptoms of involvement of lung and pleura, there may be jaundice, persistent vomiting, and oedema of the legs, due to involvement of the gall-bladder, duodenum, or inferior vena cava respectively.

With an abscess below the kidney severe constipation, due to the proximity of the colon, and shooting pain in the groin and genital organs are met with.

Pyuria is present when the kidney is the cause of the abscess, unless the ureter is closed.

If no operation is performed, either death from septicaemia results, or the abscess bursts into some neighbouring organ or on the surface through Petit's triangle. The abscess may rupture into the pleural cavity, the lung, the peritoneal cavity, the bladder, and the intestine.

Diagnosis.—The condition may be mistaken for an acute fever before the local symptoms are marked, and later for pyonephrosis—pyonephrosis differs from it in projecting forward rather than backward, in moving on respiration, and in that it never causes oedema of the skin. A pyonephrosis and perinephric abscess may occur together.

Prognosis.—Good results are obtained by prompt operation in primary cases, and the longer operation is delayed the worse the outlook for the patient.

In secondary abscesses the prognosis depends on the cause. Spontaneous cures occasionally occur when the abscess bursts through Petit's triangle. Rupture into the colon is much less favourable. Rupture into the pleural cavity is usually fatal, while rupture into the peritoneal cavity is inevitably fatal.

Treatment.—The treatment is surgical, the abscess should be opened and drained—collections of pus beneath the diaphragm, and in the iliac fossa should be searched for and opened if found. If the kidney is the seat of pyelonephritis, pyonephrosis, or an abscess, it should be freely incised and drained.

TUBERCULOSIS OF THE KIDNEY

The study of tuberculosis of the kidney is of recent date, and practically all our present-day knowledge of the subject has been collected during the last twenty-five years, since the birth of cystoscopy and catheterization of the ureters. Up to 1890 practically all observers held that the common method of infection of the kidney with tuberculosis was by the extension of the disease up the ureter from a primary site in the genital organs or bladder. To-day we know that the kidney is practically always infected from the blood, and that the infection of the lower urinary organs is secondary to it.

Up to the same date the operative treatment of renal tuberculosis was unsatisfactory and infrequent, owing to the belief that renal infection was the last stage of tuberculosis of the entire urinary tract. The valuable work of Steinthal[1] was the first to shake this belief, and his report of *post-mortem* investigations showed that the kidney was involved twice as commonly as the lower urinary tract, and that in 50 per cent of the cases only one kidney was affected. The marvellous progress of the surgical treatment of this condition during the years 1890 to 1900 will always be associated with the names of Israel, Albarran, Morris, and Tuffier.

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[1] Virchow's *Archiv*, 1885, C. 81.

Tuberculosis of the kidney may itself be primary or secondary ; strictly speaking, renal tuberculosis is never primary as it is in the lung—it is always second to a focus elsewhere, usually so small as not to be recognized. The common primary sites are lungs, Fallopian tubes, lymphatic glands, and bone. The term *primary tuberculosis* of the kidney is used in the narrower sense, and implies that the kidney is the first focus of disease in the urinary system. Renal tuberculosis occurs in two forms :

1. As part of an acute miliary tuberculosis, when both kidneys are studded with miliary tubercles. This form has no surgical interest.

2. A tuberculous infiltration of the kidney.

Method of Infection.—Tubercle bacilli reach the kidney by one of three paths : (1) ascending, (2) haematogenous, (3) lymphatic.

1. *Ascending infection* from the bladder was long regarded as the usual method of infection of the kidney. This view was based on the early occurrence of bladder-symptoms, combined with the results of experiments and *post-mortem* findings.

The clinical frequency (about 50 per cent) of unilateral renal tuberculosis is evidence against this method of infection, as in such a chronic disease one would expect both kidneys to be equally affected if it is true that the disease spreads up the ureters. It is therefore doubtful if ascending infection takes place at all.

2. *Haematogenous Infection.*—Experiments show that if tubercle bacilli are injected hypodermically and the ureter of one kidney is ligatured, tuberculosis develops in this kidney; this has been demonstrated by G. Walker[1] and other observers. Renal tuberculosis is often seen clinically without bladder-infection. Also there are many pathological specimens showing renal lesions where the rest of the urinary tract is healthy.

3. *Lymphatic Infection.*—Some observers consider this method commoner than either the ascending or haematogenous infections. Brongersma[2] believes that renal tuberculosis is frequently secondary to pulmonary or pleural tuberculosis of the same side, the disease spreading by the lymphatics. He also considers that this explains the unilateral distribution of renal tuberculosis.

Thomson Walker[3] agrees that a history of an old pleurisy is frequently obtained in cases of renal tuberculosis, but often finds the pleurisy is on the opposite side to the renal infection.

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[1] *Johns Hopkins Hospital Reports*, 1911, vol. xvi. p. 1.

[2] *Congrès de l'Assoc. Internat. d'Urologie*, Paris, 1908, p. 533.

[3] *Surgical Diseases of Urinary Tract*, 1914, p. 227.

To sum up : on the whole there is most evidence in favour of the haematogenous route, and it is doubtful if the ascending infection occurs at all.

Etiology.—Renal tuberculosis is most frequent between the ages of 20 and 40, and is more common in women than in men. In the earlier stages the disease is usually unilateral, while in the later stages it is nearly always bilateral, and much discrepancy exists between the statistics of different observers owing to their having been obtained at widely different stages in the disease and by different methods of examination. The right kidney is rather more often affected than the left.

The tubercle bacillus is usually present alone, but there may be secondary infections with *B. coli*, streptococcus, or staphylococcus.

Pathology.—In the kidney the tubercle bacillus gives rise to its typical lesions—tubercles and the formation of fibrous tissue. The following are the common varieties of tuberculous kidney :

1. *Miliary Tuberculosis.*—The bilateral miliary tuberculosis of the kidneys, as mentioned above, is of no surgical interest, but miliary tubercles affecting cortex or medulla are frequently found in the ulcero-cavernous type ; this is the only form of miliary tuberculosis of the kidney seen surgically.

2. *Ulcero-cavernous Type.*—This is the commonest type of surgical tuberculosis of the kidney. It consists in progressive destruction of the kidney-substance by ulceration, commencing in the pelvis and extending to the periphery.

The ulceration first attacks the apex of a pyramid and spreads towards its base. Several pyramids may be attacked, and the tissues between them may break down, forming a cavity. The cavity becomes lined with a rough caseous material, and outside this is a thin greyish layer, and outside again an area of intense congestion. In the cortex, corresponding to the pyramid attacked, are seen grey tubercles, solitary or in groups. These tubercles are not present in all cases.

Microscopically, as one would expect, the wall of this type of cavity shows an inner layer of caseous material, a middle layer of tubercles and giant-cells, and an outer layer of kidney-substance infiltrated with round cells. The whole kidney, or one pole only, may be much enlarged. Collections of soft rounded knobs on the surface mark out the diseased area.

In the early stage the kidney-surface may appear normal, or there may be a group of small yellow tubercles immediately beneath the fibrous capsule.

3. *Massive Tuberculosis of Kidney.*—This is a much less common form, and is usually only found *post mortem.* In this type the whole of the kidney-substance is transformed into jelly-like caseous material, separated by strands of fibrous tissue.

These kidneys are usually three to four times their natural size, and bacilli are rarely found in them. This type was first described by Tuffier, and is usually associated with a closed ureter.

4. *Tuberculous Hydronephrosis.*—This condition is rare, and may arise from the ulcero-cavernous type. It may affect the whole or part of the kidney. The fluid is usually pale and turbid, with caseous *débris.* Infection of a tuberculous hydronephrosis will produce a pyonephrosis.

5. *Lesions of Pelvis and Ureter.*—The renal pelvis becomes affected in all cases. The inflammation and subsequent ulceration extend from that part of the pelvis draining the diseased renal tissue to the whole of the pelvis. Involvement of the renal pelvis may produce a hydronephrosis by contraction of the affected area, producing a narrowed lumen. Stenosis of the upper end of the ureter from the same cause will produce a distension of the pelvis and kidney, resulting in a complete renal hydronephrosis.

The ureter is infected by bacilli carried in the urine, and the duct is usually thickened, hard, and rigid. On section an enlarged, hard, fibrous ring is displayed, and inside this is the diseased mucous membrane, which is extensively ulcerated. The lumen is small and filled with tuberculous *débris.* The ureter is frequently adherent to the peritoneum.

On the other hand there may be only one or two patches of ulceration in the duct, the rest being quite normal.

Perinephric Infections.—The fatty capsule is sometimes greatly thickened and adherent to surrounding structures. Occasionally enlarged glands are found in the fat around the hilum and along the renal vessels. Perinephric abscess occasionally results, and is due to a secondary infection of the tuberculous kidney. Bilateral renal tuberculosis is present in a proportion of the cases ; the usual method of infection of the second kidney is by the blood-stream, very rarely indeed it may ascend from a bladder which is tuberculous.

Symptoms.—In general it may be said that it is typical of this disease that symptoms referable to the kidney are usually absent. The condition of the patient is good, and all the symptoms are those of vesical origin.

The symptoms may be grouped under four headings : (1) general, (2) renal, (3) vesical, (4) urinary.

General Symptoms.—It is striking how, with severe renal tuberculosis, the general condition of a patient may for a long time remain unaltered, even when the patient has marked vesical and kidney symptoms. Occasionally patients suffer from fever, sweats, and even rigors—this group of symptoms indicating usually a pyonephrosis or a perinephric abscess. Wasting may be present. Most patients show a slight evening rise of temperature.

Renal.—Pain is a frequent symptom, and varies in character ; it may be a dull ache in the lumbar region or in paroxysmal attacks of colic, resembling those due to a calculus. The attacks of colic may be due to the passing of pieces of caseous matter or blood-clots, or to portions of calculus ; the combination of renal calculus and tuberculosis is common.

Vesical.—It is of great importance that marked vesical disturbance should be recognized as the commonest symptom of the disease. This cannot be too strongly emphasized. The cause of frequent and painful micturition is often the involvement of the bladder by the tubercular process, yet these symptoms may also be present when the bladder appears healthy on cystoscopic examination, and then they are considered to be due to the irritation of the bladder by the toxic urine. Frequency is the earliest symptom, occurring at first during the day and then at night. This may pass on to incontinence.

Pain on micturition usually develops later than the frequency, and occurs generally just before or during micturition. It occasionally follows the act. The pain varies in intensity from a tickling sensation to extreme strangury. In addition to the pain on micturition there may be a constant dull ache in the bladder-region.

Urinary.—Polyuria is an early symptom of tuberculosis, and urethral catheterization may prove it to exist only on the diseased side. The urine is pale, faintly acid, and may contain a slight amount of albumen and tube-casts. Haematuria is a variable symptom. It may be entirely absent or present only in microscopic amounts. There may be slight persistent terminal haematuria, with comma-shaped clots. An attack of severe haematuria may be the initial symptom, and may be so persistent as to necessitate operation. Albuminuria may be an early symptom, being present before the pyuria. The urine frequently contains pus, blood-corpuscles, and casts.

On examination the kidney is not usually found to be enlarged. It can sometimes be felt hard and irregular, and it is frequently tender. When felt to be enlarged the cause may be due either to hypertrophy owing to destruction of the second kidney, or to the presence of a partial or complete hydronephrosis.

Frequently there is tenderness along the course of the ureter, which may be felt as a thick cord on deep palpation of the abdomen, or on examination *per vaginam*, where it can be rolled beneath the finger in the lateral vaginal fornix.

In renal tuberculosis the onset of the symptoms is very gradual, and the progress of the disease slow.

When the symptoms have become established it is characteristic of the disease for their complete remission to occur, during which the urine may lose its pus and blood, and the pain and frequency disappear, accompanied by a gain in weight of the patient. These fluctuations are due to external influence, such as climate, diet, etc., and may last for some months, but a relapse always occurs later. On the whole there is a gradual downward progress of the disease, and death may take place some years after the onset of the symptoms. Spontaneous cure of renal tuberculosis occurs only in very rare instances, the disease usually progressing until the kidney is destroyed. Secondary infection makes the disease progress much more rapidly. This infection may come by way of the blood-stream, but much more commonly by infection of the bladder from catheterization or irrigation.

The dangers of renal tuberculosis are that it may spread to the bladder, that the second kidney may become infected, that the disease may spread to other organs, or that septic infection may be superadded. Death takes place from anuria if both kidneys are involved, or from general toxaemia if secondary infection has occurred.

Diagnosis.—The first step is to establish a diagnosis of urinary tuberculosis and then to decide its position and extent. The following questions have to be decided : (*a*) Does the disease affect one or both kidneys ? (*b*) Is the bladder involved ? (*c*) If one kidney is affected, is the other quite healthy, and what is its functional value ?

The points can be elucidated by the following methods :

1. *Urinary Examination for B. tuberculosis.*—This can be done by examination of films of the deposit of a *catheter*-specimen. The bacilli may be present in very small numbers or in abundance. The bacilli can also be found by inoculation of guinea-pigs with the suspected urine. The bacilli are more often found by this method, but it has the disadvantage that at least three to four weeks must elapse before the animal will show signs of tuberculosis.

The presence of tubercle bacilli in the urine does not necessarily mean that urinary tuberculosis is present ; but their presence, associated with such signs as pyuria or haematuria, make the diagnosis positive.

2. *Tuberculin.*—Subcutaneous injection of a small dose of tuberculin may result in a distinct rise of temperature and an aggravation of the symptoms, but, as they do not point definitely to the kidney, these methods are rarely of any help in a doubtful case.

Cystoscopy.—The bladder is healthy, and no change is observed at the ureteric orifices in early stages of the disease.[1] The urine from each kidney should be obtained and examined separately, the only reliable method being by catheterization of the ureters.[1]

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[1] See page 152.

Catheterization of the ureters yields extremely valuable information. (1) If both ureters appear healthy on cystoscopy, both should be catheterized, and the urine from each examined separately—the urine from the affected kidney may be smaller in amount, and turbid, and contain pus, blood, and tubercle bacilli, while that from the healthy kidney is normal. (2) If one ureteric orifice is obviously diseased, it is only necessary to catheterize the other ureter to find out the functional value of the second kidney.

Occasionally haematuria may be the only symptom of the disease, and in such a case the diagnosis from a small growth or from haemorrhagic nephritis can only be made by exploration of the bleeding kidney.

Treatment.—Treatment can be carried out by varying methods: (1) general (climatic and medicinal); (2) tuberculin; (3) operative.

1. *General Treatment.*—Rest in the open air is necessary. Winter should be spent in a warm equable climate if possible, such as Egypt, South Africa, South of France—if at home, Cornwall and South Devon. Urotropin is not indicated unless septic infection is present. Sandal-wood oil often soothes the irritated bladder. Washing out the bladder should not be allowed. It is of little value, and the danger of introducing sepsis by this means is considerable.

2. *Tuberculin.*—Tuberculin has not been much used in the early stage of tuberculosis when only one kidney is affected. It can be used in cases in which operation is contra-indicated. Improvement may result, but it is not possible to say if this will be permanent; on the other hand, tuberculin will not have any effect on some early cases in which the symptoms continue and the disease extends. The results of nephrectomy, in early unilateral renal tuberculosis, are so good that the adoption of tuberculin as routine treatment has not yet been tried.

In cases of bilateral renal tuberculosis, operative treatment is out of the question, and tuberculin should be tried. Improvement occurs in such cases, but no case of cure due to tuberculin has been recorded. Great care should be taken in the administration, and small doses should be used, owing to the possibility of a severe reaction causing turgescence of the ureteral mucous membrane sufficient to block the already narrowed canal.

Tuberculin is also useful in cases of renal tuberculosis with foci elsewhere, and it may be used along with nephrectomy or apart from operation.

Tuberculin treatment should begin with small doses—$\frac{1}{10\cdot000}$ to $\frac{1}{5000}$ of a mg.—

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[1] See page 168.

the tuberculin used should be T.R.—injections should be given at intervals of a week, and only increased with great care—if a severe reaction results, the dose must be diminished, and the interval between doses increased. Progress is shown by the increase in weight, the effect on pain, and frequency of micturition, and the diminution of pus and blood in the urine.

3. *Operative Treatment.*—Operative treatment of renal tuberculosis depends on an exact knowledge of the extent of the disease, and in discussing operative treatment, questions such as these must be answered :

(*a*) What is the condition of the second kidney ?

(*b*) Is the bladder infected ?

(*c*) Has the patient tuberculosis elsewhere ?

The operations that may be done for renal tuberculosis are nephrotomy, partial nephrectomy, and total nephrectomy.

Nephrotomy.—Nephrotomy is indicated under the following conditions—(1) where both kidneys are tuberculous, to relieve (*a*) a large abscess, (*b*) excessive haemorrhage, (*c*) profound septic absorption ; (2) when other methods have failed to give satisfactory evidence of the presence or absence of disease ; (3) as a preliminary operation to nephrectomy when the patient's condition is bad. Nephrectomy is performed some weeks later when the patient has regained strength.

Nephrotomy is an unsatisfactory operation, as it only relieves symptoms, and has no effect on the course of the disease—it also has the disadvantage that the patient usually has a urinary fistula for the rest of her life.

Partial Nephrectomy.—This operation consists in removal of the diseased portion of the kidney. It has been practised and recommended for the early stage of the disease. But the impossibility of deciding how much of the kidney is affected destroys any value of the operation. Owing to this fact at the present time total nephrectomy is considered to be the only radical operation for tuberculosis of the kidney.

Nephrectomy is indicated in every case in which a diagnosis of unilateral renal tuberculosis is made, and is the only operation by which a cure can be assured.

The retroperitoneal route should be employed in all cases, and an oblique lumbar incision gives free access to the kidney. The operation is much more difficult if there has been any perirenal inflammation. When the perirenal fat is not involved, the operation presents no difficulties, the kidney is thoroughly mobilized, and removed without being incised, the danger of infecting the wound with tubercle being thus avoided. The ureter, whether thickened or not, should be divided between two ligatures, and each end treated with the cautery or pure carbolic acid.

If the perirenal fat has been inflamed, the fatty capsule of the kidney is converted into a thick adherent fibro-fatty mass, and a sub-capsular nephrectomy may have to be performed owing to the difficulty of separating the thickened fatty capsule and the fibrous kidney-capsule. If the kidney is converted into a large pyonephrosis it may be necessary to tap it first—if this is done great care must be taken to avoid fouling the wound with tuberculous material ; in such a case the cavity after removal of kidney must be drained.

Treatment of the Ureter.—When the ureter is normal in appearance it is ligatured, and the end dropped into the wound. When tuberculous it can be dealt with by different methods : (*a*) It may be fixed in the lumbar wound—this method results in the formation of a tuberculous sinus, and is often done with a view to ureterectomy at a later date. (*b*) It may be ligatured and cauterized and dropped into retroperitoneal space after removal of kidney—usually this results in the ureter becoming a fibrous cord ; but if the disease remains active in the ureter, a tuberculous cystitis may be kept up by this method of leaving the ureter. (*c*) The ureter may be excised by prolonging the incision downwards and forwards towards the middle of Poupart's ligament. The entire ureter may be removed by this means, or the vesical end may be removed through the vagina (Kelly).[1] Most surgeons are content to remove the ureter as far as pelvic brim. This question of removing the ureter has usually to be settled by the condition of the patient at the end of the nephrectomy.

Contra-Indications to Nephrectomy.—The following conditions obviously form contra-indications:

(1) *Bilateral Tuberculosis.*—On the whole it may be said that nephrectomy in bilateral tuberculosis is contra-indicated, unless it be proved by various tests of renal function that the disease in the second kidney is in a very early stage.

(2) *Non-tuberculous nephritis* of second kidney may contra-indicate nephrectomy, unless this is proved by tests of the renal function to be slight.

(3) *Active tuberculous lesions of other organs* such as spinal caries, psoas-abscess, tuberculous arthritis, pulmonary tuberculosis, all contra-indicate nephrectomy for unilateral renal tuberculosis.

(4) *The general condition of patient* may contra-indicate nephrectomy, and a preliminary nephrotomy be necessary ; this may be followed by improvement, after which nephrectomy can be undertaken.

Results of Nephrectomy.—The operative mortality is about 8 per cent. As regards after-results, Thomson Walker[2] states that 10 per cent of patients who have had nephrectomy performed die within two years of tuberculosis, and that 3 per cent die of tuberculosis after a longer period than this.

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[1] Kelly and Burnam, *Diseases of Kidney, Ureter, and Bladder*, vol. i. pp. 404, 408.

[2] *Genito-Urinary Surgery*, 1914, p. 224.

CYSTITIS

Etiology.—There are at least two factors necessary for the production of inflammation of the bladder: one, the infecting organisms; the other, some condition producing lowered resistance. Neither of these factors alone is sufficient to produce cystitis. It has been abundantly shown by experiment that the mere introduction of organisms will not set up an inflammation. Also clinically, one sees that in kidney-infections large numbers of organisms regularly pass down the ureter without a resultant cystitis; should infection take place by this method it is ascribed to irritation of the area around the ureteric orifices by toxins, producing a site of lowered resistance. On the other hand, an injury, as in labour, or wounds made by surgical instruments, will not produce cystitis, but the advent of organisms, if repeated, will sooner or later give rise to the inflammatory condition.

In women, common predisposing causes of cystitis are pregnancy, retention of urine, inflammatory conditions of *cervix uteri* and Fallopian tubes, inflamed and adherent bowel and trauma; the trauma may be produced by a variety of methods: vesical calculus and lithotrity, instrumental delivery in labour, and operations on the uterus. Indeed, it is not uncommon for cystitis to follow radical hysterectomy for carcinoma of the cervix, and it is occasionally seen after abdominal hysterectomy for fibroids.

The organisms commonly found are *B. coli communis*, the tubercle bacillus, the gonococcus, the typhoid bacillus, staphylococci, streptococci, and the *Bacillus pyocyaneus.*

Cystitis due to the tubercle bacillus will be considered separately. *B. coli communis* is by far the most common organism, and is often found in pure culture; staphylococci and streptococci are found in mixed infections, but are often noticed to disappear, leaving the colon-bacillus as the persistent organism. The infecting organisms may reach the bladder from the kidneys, as in the case of the tubercle bacillus, the typhoid bacillus, and *B. coli communis*, the latter being the organism most commonly conveyed by this channel. Infection may be introduced by way of the urethra, as in gonorrhoea, or by the passage of an unclean instrument. Bacteria may invade the bladder-wall from neighbouring structures—for example, in a suppurating ovarian cyst or from adherent bowel; a fistula forms between them, and violent inflammation of the bladder rapidly occurs.

As only very acute cystitis gives rise to any *post-mortem* change, little information can be obtained from this source. Consequently we must rely on cystoscopic examination in investigating the changes occurring in cystitis.[1]

Symptoms.—The symptoms of cystitis are frequency of micturition, with polyuria, pain, and changes in the urine. Increased frequency of micturition is usually the earliest symptom, and it varies with the intensity of the cystitis, the interval between the acts of micturition ranging from one to two hours in slight cases, to every few minutes in serious ones. In the latter cases the frequency is equally severe, both day and night, amounting almost to incontinence. Pain is a variable symptom ; there is a burning pain in the urethra on passing water ; there may be discomfort at the end of micturition. In severe cases there is a sense of pressure often amounting to definite pain in the lower abdomen. Polyuria is associated with the frequency, and is supposed to be due to a reflex which affects the kidney. The urine is usually pale and hazy, and of low specific gravity, but, on the other hand, where the infection is severe, it may be scanty and offensive. The reaction of the urine is not constant, but it is always acid in cases due to *B. coli communis* and the gonococcus. It is alkaline, however, in quite half the cases, and this is due to the decomposition of urea by organisms, giving rise at times to ammoniacal urine. Pyuria is always present, but varies in amount ; the pus is mixed with mucus, and will form a sediment on standing in a specimen-glass. This is usually a whitish semi-translucent mass, but in severe cases it may be a slimy gelatinous deposit, which clings to the glass. The amount of pus is liable to a sudden variation only in those cases in which some condition permitting the accumulation and sudden discharge of pus co-exists, *e.g.* pyelitis, vesical diverticula. Haematuria is only present in the most violent infections. Fever is usually absent in uncomplicated cases of cystitis. There is tenderness both on pressure above the pubes and on examination *per vaginam*, and by this route the bladder can be felt thickened and contracted. The capacity of the bladder is an indication of the severity of the inflammation. The more acute the attack the less fluid will the bladder hold.

Cystoscopy is inadvisable in acute cystitis, and should not be performed until the acute stage has passed off. Cystoscopy shows that the part of the bladder usually affected is the base, in descending infection the area around the ureteric orifice is seen to be inflamed as well as the base ; when the bladder has been infected *via* the urethra, the trigone is the part most generally affected.

Diagnosis.—The diagnosis of cystitis has to be made from a considerable number of conditions which present one or more of the symptoms of this disease. Frequency of micturition is present in conditions where large quantities of urine are passed—*diabetes mellitus*, *diabetes insipidus*, early chronic Bright's disease, and hysterical polyuria. Frequency is also caused by pressure on the bladder, as in pregnancy, uterine and ovarian tumours, and in uterine prolapse. In none of these conditions is there pyuria. Pain in the bladder, or on micturition, is present in the vesical crises of tabes, in urethral caruncle, and in some cases of oxaluria and phosphaturia. But pus is absent from the urine in these diseases. Vesical pain and frequency of micturition are present in diseases of the kidney, tuberculosis, calculus, pyelitis, and pyonephrosis—pyuria is met with in these conditions, and the diagnosis from cystitis can only be made by cystoscopy and examination of the urine.

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[1] See page 140.

In the above diseases of the kidney, infection of the bladder occurs at times, and in such cystitis is usually spoken of as *secondary*, the term *primary* being then reserved for those cases in which other sites of infection are absent as causal agents of the cystitis.

To establish a diagnosis of renal disease where the symptoms point only to bladder-infection is most important, as has been emphasized before in tuberculosis of the kidney. The examination of the urine is helpful, as it sometimes contains tube-casts. The reaction is not a reliable sign, as it varies both in renal and vesical conditions. The pus in pyelitis, pyelonephritis, and in pyonephrosis is greater in amoun than in cystitis; it is also liable to sudden and considerable variations in quantity; in cystitis these variations in the amount of pus do not occur. In cystitis, secondary to renal disease, cystoscopic examination will often show the inflammation to be limited to the area around one ureteric orifice, and the urine from that ureter is purulent. A fistulous communication between intestine and bladder has sometimes set up cystitis; this condition would be diagnosed by urinary examination and cystoscopy.

Treatment.—The treatment of cystitis varies slightly with the stage of the disease; it should be differently treated in the three following stages:

1. *Acute Stage.*—In acute cystitis the patient must be kept in bed, and treatment should be chiefly sedative, as the bladder is particularly irritable and tender. Diet should be light and almost entirely fluid. Alcohol should be completely withheld. Non-irritating drinks, such as water, barley-water, Vichy, and Contrexéville water, should be given in large quantities. Hot hip-baths may be ordered two or three times a day; hot fomentations may be applied over the lower abdomen and perineum. At this stage it is generally found that vaginal douching is too painful to be borne. The bowels should be kept freely open by saline purges. Various drugs may be given; if the urine is strongly acid it is best to prescribe an alkali, such as

citrate and bicarbonate of potash in 20-grain doses of each; in cases of painful vesical spasm and strangury the tinctures of belladonna, hyoscyamus, and opium may be given by mouth.

Morphia may be also administered by suppository, or, when the pain is very severe, it may be given hypodermically. No attempt can be made to pass a catheter or to wash out the bladder.

2. *Subacute Stage.*—This usually commences ten to fourteen days after the onset of symptoms. The patient may get up, and a more varied diet allowed—alcohol, highly spiced foods, curries, coffee, and condiments such as mustard, pepper, and chutney, must be forbidden. Urinary antiseptics should be given by mouth, either urotropin, helmitol, or salol, 10 grains of each. If the urine is acid, as in *B. coli cystitis*, alkalis must be given. If the urine is alkaline and ammoniacal, as in mixed infections, boric acid (15 grains) may be given; sodium acid phosphate (25 grains) combined with urotropin is also very useful. Vaccine-treatment with an autogenous vaccine often accelerates recovery in this stage. Bladder-irrigation may be begun as soon as the acute symptoms have passed off. In this method of treatment the patient should lie on her back, and an irrigating can may be tied to the bed-head or a funnel held 2 or 3 feet above her. A large rubber catheter is sterilized and passed into the bladder, and the fluid is allowed to distend the bladder until the patient feels slightly uncomfortable, when the fluid is run off. This is repeated several times, and large quantities are used. A two-way catheter can be used, but is not so efficient as the ordinary type.

Irrigation of the bladder is carried out by various solutions. Normal saline; weak potassium permanganate about 1 in 5000; biniodide of mercury 1 in 10,000; nitrate of silver 1 in 10,000. The temperature of the fluid is about 100° F., but may go as high as 105° F. The irrigation should be performed once or twice daily.

3. *Chronic Stage.*—When the disease has become chronic a careful cystoscopic examination should be made to eliminate an extra-vesical cause of the cystitis. Should any such cause be found the cystitis can only be cured by dealing with the cause. The same restrictions as to diet are made, and similar drugs can be tried as in the subacute stage. Vaccine-treatment with autogenous vaccines may do good. Bladder-irrigation should always be used. Drainage of the bladder, with daily washings or continuous irrigation, may become necessary. Small quantities of stronger solutions than those used in irrigation may be injected into the bladder through a catheter. Such solutions are silver nitrate 2 to 5 per cent, protargol 2 per cent.

Bladder-drainage is carried out either through the urethra or by opening the bladder. In urethral drainage in women, a self-retaining rubber catheter is always used. This may be left in for about a week, and by continuous drainage it prevents distension and puts the bladder completely at rest; the majority of patients will not tolerate this type of catheter for more than a few days together, and it must be kept clean by thoroughly irrigating the bladder once or twice daily.

Drainage can also be established by means of a vesico-vaginal fistula. This procedure should be applied only to those chronic cases which, resistant to treatment, are painful and intolerant of all forms of local applications, and also in cases of ulcerative cystitis. It is a serious step in treatment, as it condemns a patient to several weeks in which urine is constantly running away, and in 50 per cent of cases to a permanent fistula, which necessitates an operation for its repair. These points must be very carefully weighed before adopting this treatment. The effect of drainage, as remarked above, is to put the bladder completely at rest, and also to keep it clean, and this method is much more efficient than urethral drainage by a catheter.

The operation is done by putting the patient in the lithotomy position. A bladder-sound is passed, and the point of the sound turned down towards the vagina until it bulges in the anterior vaginal wall. The posterior vaginal wall is kept out of the way by a Sims' speculum. An incision is now made with a sharp scalpel on to the point of the sound; the incision should be increased to about 1 inch in length. The mucous membrane of the bladder should next be sutured to the vaginal mucous membrane to prevent too rapid closure of the incision. This can be easily done by interrupted catgut sutures. In a patient with a small vaginal orifice it may be necessary at the operation to incise the perineum, to ensure no blocking of the drainage at the vaginal orifice. By means of the vesico-vaginal opening two other methods of treatment can be adopted: first continuous irrigation; this is carried out by a catheter in the urethra, conveying fluid into the bladder from an irrigating can raised some feet above the level of the bed. The fluid drains out by the fistula into a bed pan on which the patient lies, and from this it is carried away to some large receptacle on the floor at the bedside. Secondly, it permits of direct applications being made to the inflamed area, and in the case of single chronic ulcers of their excision through the vesico-vaginal opening.

Tuberculous Cystitis

Tuberculosis of the bladder may be primary when it is the original site of the disease in the urinary system, or secondary when it arises secondary to tuberculosis of the kidney, and in man, of the genital organs. At the present time it is extremely doubtful if the primary form ever occurs, and it is said to be less common in women than in men. Casper[1] describes 3 cases of apparently primary tuberculosis of the bladder. When the bladder is attacked primarily the tubercle bacilli are conveyed by the blood-stream. When both the kidney and bladder are tuberculous it has been a much-disputed question as to which is the primary site of infection, and whether the disease descends from the kidney to the bladder or ascends from bladder to kidney. This question has been very thoroughly discussed in the pathology of renal tuberculosis, and the conclusion arrived at is that the kidney is almost always the primary site, and that it is doubtful if ascending infection of the kidney from the bladder ever occurs at all. In women the combination of genital and urinary tuberculosis is very rare, and infection of the urinary tract from disease of the genital organs does not occur at all.

Pathology.—The disease is frequently limited to certain parts of the bladder. It is often found around the ureteric orifice on the side of the diseased kidney, but it may be situated on any part of the mucous membrane of the bladder. The tuberculous process begins in the mucous membrane as a collection of greyish tubercles ; these become yellow from caseation and then break down, forming a small superficial ulcer with well-defined edges. Several of these minute ulcers coalesce and form a larger ulcer. In long-standing cases the bladder becomes small, the perivesical fat becomes thickened and fibrous, and adherent to intestines and genital organs. The pelvic lymphatic glands are tuberculous. Secondary involvement of the uterus, Fallopian tubes, or ovary is very rare.

Symptoms.—The onset is insidious, and the disease progresses slowly but persistently. The symptoms begin as those of a spontaneous cystitis, and they vary in intensity with changes in climate and diet. Frequency is the earliest symptom, at first only in the day, and at two- to three-hourly intervals it soon appears at night, and becomes so frequent as to disturb sleep very considerably. Pain is very severe if any attempt is made to hold the urine. There is burning pain on micturition. Haematuria may occur, and is not an uncommon symptom ; it varies in amount in different patients. The urine is pale, acid, and of low specific gravity ; it contains pus and tubercle bacilli. The quantity of pus does not undergo marked variations, and is usually small.

Complications.—The most important from its frequency and severity is the addition of sepsis. It almost always follows the passing of instruments or washing out of the bladder. The organisms usually responsible are *B. coli communis*, staphylococcus, and streptococcus. Mixed infection produces a marked increase in the symptoms, a spread of the disease in the bladder, and occasionally an extension to the kidney, producing septic pyelonephritis, which may end fatally.

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[1] *Deutsche med. Wochenschr.*, 1900, vol. xxvi. p. 661.

Prognosis.—As tuberculous cystitis is almost always secondary, the prognosis depends on the progress of the primary lesion. When it is secondary to unilateral renal tuberculosis and nephrectomy is performed, the disease in the bladder may disappear without further treatment. Generally speaking, the course of tuberculous cystitis is slowly downhill, though interrupted by periods of improvement and relapse. If sepsis is avoided, death after some years is usually due to bilateral renal tuberculosis, but if a septic infection is superadded, the course is much shorter, ending in acute or chronic septic pyelonephritis.

Diagnosis.—To establish the presence of a tuberculous lesion in the bladder in any case of cystitis, the most important methods of examination are urinary and cystoscopic. In the examination of urine the discovery of *B. tuberculosis* is the essential and conclusive fact. Characteristic appearances are also seen on cystoscopic examination.[1]

The diagnosis of primary vesical tuberculosis should never be accepted as conclusive until renal tuberculosis has been excluded by ureteral catheterization and separate examination of the urine from each kidney.

Treatment.—When tuberculous cystitis is secondary to unilateral renal tuberculosis, removal of the affected kidney as a rule results after some intervals in the cure of the cystitis. When bilateral renal tuberculosis is present, or in cases in which the cystitis does not clear up after nephrectomy, further treatment is necessary for the cystitis.

General treatment is the same as that described above for renal tuberculosis.

Local Treatment.—Instillations and bladder-irrigation may produce some temporary improvement, but their use always entails the possibility of sepsis being added to the tuberculous infection. Local applications may be made through the direct cystoscope; ulcers may be curetted or cauterized by this means.

Opening the bladder through the anterior vaginal wall allows drainage of the bladder or treatment of ulcers. The ulcer, in the rare cases in which it is solitary, may be excised, it may be curetted, or cauterized. Applications of strong caustics may be performed in this way. The great disadvantage of opening the bladder in tuberculous cystitis is that sooner or later sepsis is introduced, and the condition of the patient becomes worse than before treatment.

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[1] See page 152.

HERNIA IN WOMEN

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Introduction

For the general surgeon the subject of hernia in women, as compared to hernia in men, has special points of interest in incidence, etiology and clinical aspect. For the gynaecologist, if we assume that the gynaecologist is a limited practitioner who confines his attention to the affections of the female generative organs, hernia may not be a subject which comes strictly within his province. But it is a subject which he cannot overlook, for it frequently forces itself upon his attention in the consulting-room, on the operating-table, and in the laboratory. If any apology were needed for including an article on hernia in a text-book on gynaecology, many points immediately suggest themselves.

Hernial swellings of the vulval, vaginal, perineal, and inguinal regions often simulate, and have to be differentiated from, swellings of another nature, such as abscesses, cysts, new growths, and prolapses. The female generative organs are not infrequently found in a hernial sac and may there become the seat of various changes, such as inflammation, strangulation, tumour-formation, and pregnancy; such contents make a hernia of considerable scientific and clinical interest for the gynaecologist. Of equal interest are those cases of malformation of the external genitalia, including pseudo-hermaphroditism, so often accompanied by hernial swellings of the inguinal region. Hernias may complicate co-existing gynaecological disease and may demand interference during pregnancy. Scar-hernia comes strictly into the province of the gynaecologist; as a primary operation he may have to deal with a faulty scar resulting from one of his own operations, or he may have to approach a pelvic condition through the site of a pre-existing scar-hernia.

Finally, certain forms of perineal hernia may be claimed by the gynaecologist as his own.

The purpose of the present article is not to deal with hernia in all its surgical detail, but to give an account of the relationship of hernia to women in general, and to gynaecological conditions in particular.

General Incidence.—Inguinal hernia is the commonest variety of hernia in women, as it is in men. Femoral hernia is commoner in women than in men ; so also are the rarer varieties of hernia—obturator, sciatic, and perineal. Ventral hernia has about an equal incidence in the two sexes.

Although inguinal hernia is the commonest variety in women, it is very much less common than in men. To quote only one set of statistics, Judd [1] has reported from the *Mayo Clinic* that of 1429 persons operated on for inguinal hernia, only 119 were women. In men nearly all hernias are inguinal ; in women the inguinal are only slightly in excess of the other varieties. Macready [2] gives the proportion of inguinal to femoral in women as 6 : 4, and Berger [3] states that 44·3 per cent of female hernias are inguinal and 32·7 femoral. Examining the matter more closely, the fact comes out that in the female sex the majority of inguinal hernias occur in infancy and childhood ; in the child-bearing period, sixteen to fifty, the femoral hernias are nearly equal to the inguinal, and after fifty the femoral are slightly in excess. From the above considerations, it is apparent that hernia in general is relatively uncommon in the female, as compared with the male sex.

Special Etiological Factors.—*Occupation.*—The muscular strain of laborious occupation does not occur to the same extent in women as in men, and this may reasonably be held to contribute to the relative immunity of women to hernia in the working period of life.

Pregnancy and Labour.—Pregnancy and labour might well be thought to be factors in the causation of hernia, but that they can only be so to a very limited extent is apparent when the millions of women who bear children are compared with the few who acquire hernia. Nevertheless, hernias are of far more frequent occurrence in women who have borne children than in those who have remained sterile. Heineck [4] found that, in a series of 978 women afflicted with inguinal hernia, 772 were mothers, and more than 600 of these had borne two or more children. Theoretically, pregnancy should favour the occurrence of hernia : it stretches, attenuates, and weakens the abdominal wall and widens the hernial orifices : it loosens the connective tissue and relaxes the mesenteries and other means of visceral support. The expulsive efforts of labour cause a rise in intra-abdominal pressure so great and unexpected that it might well be thought capable of forcing viscera through an already weakened abdominal wall; and so, no doubt it might, were it not for the fact that the enlarged uterus protects the hernial orifices and keeps back the viscera.

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[1] Judd, see Royston, *Amer. Journ. Obsts.*, 1911, vol. lxiv. p. 472.

[2] Macready, *A Treatise on Ruptures*, London, 1893.

[3] Berger, *Résultats de l'examen de dix mille observations de hernies*, etc., Paris, 1896.

[4] Heineck, *Surg., Gyn., and Obstets.*, 1912, vol. xv. p. 63.

All that can be affirmed is that multiparae are more affected than nulliparae, that many hernias first appear after child-birth, and that, after delivery, many hernias show an increase in volume.

The Female Pelvis.—The shape of the female pelvis is stated to favour those hernias which are commoner in women than in men. The greater expansion of the iliac crests allows increased space beneath Poupart's ligament and favours femoral hernia; the greater capacity of the pelvis and the greater transverse diameter favour obturator and sciatic hernia; the wide transverse outlet favours perineal hernia. In all these varieties child-birth is an additional factor of importance.

The Inguinal Region.—An enquiry into the anatomy of the inguinal region shows that there are certain structural characteristics of the inguinal canal and of the internal and external rings which help to confer on women their relative immunity to inguinal hernia; some of these characteristics depend on the relatively wide transverse diameter of the pelvis.

The capacity of the inguinal canal is smaller since it contains only the round ligament, an insignificant structure compared with the spermatic cord and blood-vessels. The internal oblique muscle has a more extensive origin from Poupart's ligament, affording additional strength to the anterior wall of the canal. According to Turck,[1] (1) the average length of Poupart's ligament in the male is 11·2 cm., and in the female 12·5 cm.; (2) the average length of origin from Poupart's ligament of the internal oblique muscle is in the male 8 cm., and in the female 9·9 cm. Expressed in another way, the muscle arises from the outer two-thirds of the ligament in the male, and from the outer four-fifths in the female. Still another point: in the male the muscle gives up some of its innermost fibres to the formation of the cremaster muscle.

Another point brought out by Turck is that the internal ring lies at a higher level above Poupart's ligament and nearer the anterior superior spine. His figures, gained by the examination of a large number of female bodies, are as follow:

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[1] Turck, *Journ. Amer. Med. Assoc.*, 1899, April 15.

	In Male.	In Female.
Height of the internal ring above Poupart's ligament . .	2·2 cm.	2·56 cm.
Distance of the internal ring from pubic spine . . .	6·4 ,,	7·67 ,,
Distance of the internal ring from anterior superior spine .	5·8 ,,	5·8 ,,

The higher the ring above Poupart's ligament, and the nearer the anterior superior spine, the greater its protection, for the more firmly will it be covered by the internal oblique muscle, whose fibres increase in size and strength in a direction upward and outward from the lowest point of origin.

Finally, the female external ring is a very small opening.

Congenital Hernial Sacs.—An enquiry into the congenital factor in the causation of hernia in women is limited to inguinal hernia, since, as in the male sex, preformed sacs are of frequent occurrence in the inguinal but are rarely found in other hernial regions. Congenital umbilical hernia, common to either sex, is an exception.

The persistence of the canal of Nuck is an etiological factor of the greatest importance. The morphology and dates of origin and disappearance of this peritoneal diverticulum are still the subject of controversy. By some it is considered a normal structure, homologous to the *processus vaginalis* in the male, present in the foetus and disappearing at or shortly after birth ; by others it is regarded as an abnormal process. If it is homologous to the peritoneal process in the male, it is only so in structure and location, and not in function. The *processus vaginalis testiculi* is a temporary process, developmental in function, and necessary for the complete descent of the testicle ; the canal of Nuck serves no such developmental function.

Investigators have differed : Duplay[1] was unable to find any trace of it in 21 female foetuses between the ages of four and five months, and his results have been supported by Biermer[2] and Heegard ;[3] Camper found the canal open in the new-born in 21·4 per cent ; Sachs and Féré found it open in infants between the ages of one day and one year in about 16 per cent, and Wrisberg, in bodies of various ages, in 9·5 per cent. Waldeyer[4] describes the canal as if it were a normal structure in the foetus.

All that can be affirmed, for practical purposes, is that the canal is usually obliterated at birth, that it may not close until after birth, and that, in rare cases, it may persist throughout life.

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[1] Duplay, *Thèse*, Paris, 1865 (see *Archiv f. klin. Chir.*, 1904, Bd. lxxiv.).

[2] Biermer, *Zentralbl. f. Gyn.*, 1897, p. 223.

[3] Heegard, *Archiv f. klin. Chir.*, 1904, Bd. lxxiv. p. 424.

[4] Waldeyer, *Zentralbl. f. Gyn.*, 1896 and 1898.

The relation of the canal to the round ligament is an important one. Besides accompanying the round ligament in the inguinal canal, and sometimes descending as low as this ligament into the *labium majus*, it is intimately adherent to it. This intimate connection of the canal with the ligament has been emphasized by many anatomists and surgeons ; by some the ligament is described as being inserted into the apex of the canal, while others have noticed that the ligament is only partially surrounded by the peritoneum of the canal. Carmichael,[1] from observations made during the course of operations on congenital inguinal hernia in children, writes : " In many of the cases operated on, the round ligament was seen distinctly passing up towards the apex of the canal ; many of the fibres appeared to spread out over the canal, but the majority seemed to form a band which passed behind and internal to the sac, though apparently intimately associated with it."

Artificially, the canal can be formed in the cadaver by excessive traction on the round ligament, and during the performance of an Alexander-Adams operation the same can be demonstrated in the living subject. Carmichael believes that the canal of Nuck is due to excessive traction resulting from imperfect development or shortness of the round ligament ; this is an interesting speculation, but it requires more proof.

The majority of female inguinal hernias are present at birth or arise in childhood, and are therefore of congenital origin. In adults it is difficult to say what proportion are of congenital origin even at operation. Heineck gives the following anatomical characteristics as strongly suggestive of a congenital origin in female inguinal hernias : great vascularity, absence of subserous fat, folds, valvular or diaphragmatic constructions, cyst-formations, scar-like indurations of the walls or the sac, intimate adhesion of the round ligament to the sac.

It is interesting to compare the canal of Nuck with a persistent *processus vaginalis testiculi* as a causative factor in hernia ; the canal of Nuck is a small and narrow process compared with the former, and therefore less likely to acquire contents and become a hernial sac ; the relative frequency with which they occur in the two sexes is uncertain.

Which of the factors—absence of muscular strain, protective anatomical structure of the inguinal region, or the nature of the congenital sac—is the most important in determining the relative immunity of women to inguinal hernia is an interesting but unprofitable speculation.

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[1] Carmichael, *Journ. of Obstet. and Gyn. of Brit. Emp.*, 1906, vol. x.

INDIVIDUAL VARIETIES OF HERNIA

Inguinal Hernia.—In women inguinal hernia is nearly always of the *indirect* or *oblique* variety, commencing at the internal ring and traversing the inguinal canal; the *direct* variety of hernia is extremely uncommon. *Interstitial* inguinal hernia, at one time regarded as essentially belonging to the male, occasionally occurs in the female; but it is so occasional that it has merited special papers dealing with the published cases. Auvray [1] in 1900 was able to collect 13 cases, of which 5 were 'hernia en bissac,' and Cristini [2] in 1913 published an account of 29; strangulation appears to be an extremely common complication and occurred in 10 of Auvray's and in 19 of Cristini's cases. The sac may be found, as in the male, between the peritoneum and transversalis fascia (*properitoneal hernia*) or between the oblique muscles (*interparietal hernia*). Tubby [3] has published a case where the Fallopian tube and ovary were found in a hernial sac between the transversalis and internal oblique muscles, outside the internal ring. The third variety of interstitial hernia, where the hernia escapes as usual through the external ring, but travels outwards along Poupart's ligament (*proparietal hernia*), generally in the male associated with late descent of the testicle and a contracted state of the scrotum, does not seem to have been reported in the female sex.

Further references to interstitial hernia in women may be found in papers by Tourneaux [4] and Berger; [5] absence or extreme narrowness of the external ring, and tumours growing in the canal immediately above the external ring have been described in some cases, whilst Berger looks upon abnormal forms and diverticulae of the canal of Nuck as the chief causative factor.

Diagnosis.—The diagnosis depends on the signs and symptoms common to all hernias, with the addition of the special features due to the hernial site. In the early stages, a fulness is noticed in the inguinal canal, which increases in size and becomes tense when the patient strains or coughs. The expansile impulse in coughing is best noted by introducing the tip of the finger into the canal by pushing the skin of the *labium majus* through the external ring. When the hernia increases in size it fills the whole length of the canal and, coming through the external ring, causes a swelling of the *labium majus* of the corresponding side—labial hernia.

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[1] Auvray, *Bull. et Mém. Soc. de Chir. de Paris*, 1913, n.s. vol. xxxviii. p. 717, and *Gaz. Hebdom.* No. 46, p. 542.

[2] Christini, *Thèse de Lyons*, 1909.

[3] Tubby, *Brit. Med. Journ.*, 1897, vol. ii. p. 969.

[4] Tourneaux, *Bull. et Mém. Soc. de Chir. de Paris*, 1913, n.s. vol. xxxviii. p. 594.

[5] Berger, *Revue de Chir.*, 1902, vol. xxv. p. 1.

The association of an inguinal hernia with a hydrocele of the canal of Nuck is extremely suggestive of a congenital origin.

When the hernia has not passed beyond the external ring (incomplete variety or bubonocele) it has to be distinguished from certain other swellings in the region of the inguinal canal.

1. Hydrocele of the canal of Nuck. This swelling is smoother, tenser, more globular, and has more sharply defined outlines than a hernia ; the expansile impulse on coughing is absent ; it is irreducible, and by means of transmitted light, unless it contains blood or pus, its contents appear translucent.

2. A chronic abscess, originating from the abdominal wall or within the abdomen or pelvis, or from tuberculous disease of the spine (psoas abscess), may point in or near the inguinal canal. Such abscesses always give an expansile impulse on coughing, and are sometimes reducible, but they have not the definite outline and characteristic sensation of a hernia, being usually soft and fluctuating. Other clinical evidence of the particular disease from which the abscess has originated is usually sufficient to determine the diagnosis.

3. Enlarged glands in the groin, which have become adherent to the external oblique aponeurosis, give a heaving impulse on coughing and may be mistaken for hernia ; exploration of the inguinal canal with the finger will usually settle the diagnosis.

4. Fibroma of the round ligament. The solid consistence of this swelling, the well-defined outlines and mobility, the absence of expansile impulse on coughing, and irreducibility admit of easy differentiation from hernia.

5. A lipoma, originating in the subperitoneal fatty layer, sometimes makes its way through the internal abdominal ring into the inguinal canal, but is much less common here than in the *linea alba*, umbilical or femoral regions. It may usually be distinguished from hernia by the absence of expansile impulse and by the limitation of its upper border. On the other hand, a lipoma may be simulated by a mass of fat resulting from a protrusion of the subperitoneal tissue with a hernial sac imbedded in its interior.

Femoral Hernia.—The sac and its contents pass from the abdominal cavity along the course of the so-called crural canal, and appear in the front of the thigh at the site of the saphenous opening. The crural canal is not a preformed canal, like the inguinal, but is a potential canal lying along the inner side of the femoral vein, and occupied by fatty and cellular tissue and lymphatic vessels ; it becomes a true canal when canalized by the passage of a hernia. The crural canal is about three-quarters of an inch in length along its anterior, and about one and a half inches along its posterior wall: as the sac leaves the abdominal cavity, it passes through a ring (the crural ring) formed by the fibrous sheath of the femoral vessels externally, by Gimbernat's ligament internally, by Poupart's ligament anteriorly and by the iliac fascia covering the pubic ramus posteriorly. As the sac descends, it pushes in front of it that part of the subperitoneal tissue and transversalis fascia known as the *septum crurale,* opens up the cellular tissue space along the inner side of the femoral vessels, and finally appears under the skin of the thigh by pushing ahead of it the cribriform fascia of the saphenous opening. Once it has emerged from the saphenous opening a femoral hernia travels upwards and outwards towards the anterior superior spine, being guided in that direction by the attachment of the deep layer of the superficial fascia; large femoral hernias may extend considerably above the level of Poupart's ligament.

A femoral hernia forms on the inner side of the thigh a rounded swelling, which gives an expansile impulse on coughing, and is more or less reducible. More exact information may be gained by feeling the neck of the sac, which is found to lie below Poupart's ligament, to the inner side of the femoral vessels, and below and external to the pubic spine. These relations are usually easily determined in hernias of moderate size, but in large hernias which have passed above Poupart's ligament, and especially where the hernia has become irreducible or strangulated, and in obese patients, the exact location of the neck of the sac may be extremely difficult.

Diagnosis.—In the differential diagnosis inguinal hernia presents the chief difficulty, and the other swellings in the femoral region which have to be distinguished are an enlarged lymphatic gland, lipoma, chronic abscess, and varix of the saphena vein.

1. Inguinal Hernia. The only way to arrive at a differential diagnosis is carefully to explore the relations of the sac, especially of its neck. In inguinal hernia, the neck of the sac occupies the inguinal canal, is above Poupart's ligament at its point of exit, is above and internal to the pubic spine, and the sac tends to pass into the *labium majus.* In femoral hernia, the inguinal canal is unoccupied, the neck of the sac lies below Poupart's ligament, and below and external to the pubic spine; the sac does not tend to pass into the *labium majus* but travels upwards and outwards.

2. An enlarged lymphatic gland seldom causes difficulty, for the general signs of hernia, such as reducibility and impulse, are absent. In obese women it is often impossible to distinguish between an enlarged gland and an irreducible omental hernia except by an exploratory incision.

3. A subperitoneal lipoma, pushing its way down the crural canal, is often

difficult to distinguish from hernia. But, usually, the absence of general signs of a hernia, the mobility and definite outlines of the tumour, are sufficient to distinguish it.

4. A psoas abscess pointing at the saphenous opening gives the hernial signs of reducibility and impulse on coughing. It is distinguished by the facts that as it passes under Poupart's ligament it lies to the outer side of the femoral vessels, that distinct fluctuation can be obtained between the swelling in the thigh and the pelvic part of the abscess which can usually be felt in the iliac fossa, and that the patient will present characteristic signs and symptoms of spinal caries.

5. A varix of the saphena vein sometimes forms a pouch at its entrance into the femoral vein, which may be mistaken for a femoral hernia because of its marked impulse on coughing and because the swelling disappears when the patient lies down. But the swelling, and the impulse it gives, is of an entirely different character from that of a hernia ; the blood can be felt driven past the examining finger with a thrill, and the stethoscope often reveals a humming murmur over the tumour.

Umbilical Hernia.—It is usual to describe three varieties of umbilical hernia : (1) the congenital hernia into the umbilical cord ; (2) the umbilical hernia of infants and young children ; (3) the umbilical hernia of adults.

1. *The congenital hernias of the cord* are to be regarded as the result of persistence of an embryological condition and not as true hernial protrusions. In early embryonic life the base of the cord is widely open and contains the vitelline intestinal loops ; by the end of the third month the loops of intestine are withdrawn into the body-cavity and the umbilical opening is closed except for the transmission of the umbilical vessels. Congenital umbilical hernia represents failure of this process. All degrees are met with from a large cystic tumour at the base of the cord, containing the bulk of the intestines, to a small expansion containing a single loop of intestine or a Meckel's diverticulum. Bullard [1] has recorded a case of congenital hernia of the liver into the base of the cord and has collected 128 similar cases from the literature.

The slighter forms are sometimes unrecognized when the child is born, and the contained intestine is either strangulated by the ligature or is actually divided with the cord. Fatal strangulation or, at best, a faecal fistula will then result. When recognized, the contents of the hernia should be carefully reduced, the cord ligatured and divided beyond them, and a sterile wad of gauze bound firmly over the stump. Strips of adhesive plaster may be used and arranged so as to draw the recti muscles into apposition.

In the larger forms, the outlook for the infant is a poor one. If possible, the proper thing to do is to reduce the contents, excise the sac, and bring the edges of the opening into apposition by a suitable method of suturing.

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[1] Bullard, *Amer. Med.*, 1902, vol. iv. p. 742.

Occasionally cases are met with where a short proximal length of apparently normal cord intervenes between the umbilicus and a cystic dilatation of the cord containing numerous coils of intestine ; in such cases the proximal pedicle of cord ensheathes, of course, an entering and a returning loop of intestine with mesentery, and forms a kind of pedicle for the hernia. Under such circumstances the liability to misinterpret the nature of the swelling is considerable. Such a case was recently reported by Victor Bonney,[1] in which the proximal, apparently normal, part of the cord had been ligatured, in ignorance that the cyst was a hernia containing intestine. " The child was seen twenty-four hours after its birth. Its facies was ' pinched,' but otherwise it appeared fairly vigorous. In the stump of the cord the two cut ends of the intestine were visible. Novocain was injected round the umbilicus, the ligature removed, and the opening into the abdomen slightly enlarged. After a few small vessels in the mesentery had been ligatured, the two ends of the bowel were joined together by end-to-end anastomosis, after which the umbilicus was closed by sutures. The child's condition remained unchanged by the operation, but twelve hours afterwards it suddenly expired. A *post-mortem* examination showed that nearly all the intestine had been removed with the hernial sac, the operation having effected a junction between the top part of the jejunum and the lower end of the pelvic colon."

Cases have been recorded in which the umbilical ring itself is constricted and forms a species of pedicle for the hernia. Ahlfeld [2] has recorded such a case in which the proximal portion of the hernia had undergone shrinking and constriction, and the intestine contained within it, consisting of a part of the caecum and the vermiform appendix, and the terminal part of the jejunum, had become entirely cut off.

2. The umbilical hernia of children is due to yielding of the umbilical cicatrix before the intra-abdominal pressure. Considering the constant crying and straining during the first few months of life, it is a wonder these herniae do not occur oftener ; indeed, many are not noticed and are cured spontaneously.

The hernia is generally noticed soon after birth as a little bulge at the umbilicus when the child cries. With rare exceptions, it is quickly cured by simple treatment. A good method is to apply adhesive straps over the skin of the abdominal wall in such a manner that the umbilicus is tucked inwards, the folds of skin over it being brought together like a buttress. Another method is to fix over the umbilicus a flat pad, such as a penny covered with lint. The pad must be managed with care, the skin kept dry, and the pad covered afresh every day.

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[1] V. Bonney, *Proc. Roy. Soc. Med.* (*Obstet. and Gyn. Sect.*), 1914, vol. vii. pt. ii. p. 228.

[2] Ahlfeld, *Archiv f. Gyn.*, 1873, p. 232.

If the hernia is not cured by persistent use of these means, operative treatment is necessary, which is quite satisfactory, as there is no excess of fat, the opening is small and the sides are easily brought together.

3. *The Umbilical Hernia of Adults.*—The true umbilical hernia of adults is rare; indeed some surgeons maintain that a hernia never makes its exit through the umbilical ring in adults. In the true umbilical hernia the protrusion occurs through the upper part of the ring where the loosely attached vein offers less resistance than the more firmly attached arteries below. In the majority of cases the so-called umbilical hernia occurs through an opening immediately above or below the ring, the former being the more common.

The coverings of these hernias are subperitoneal fat, fascia, and skin. The sac always contains omentum, usually with colon and sometimes with small intestine. The omentum is often much thickened by the depositions of extra fat or by inflammatory exudate. When the hernia is of large size the skin over it becomes stretched and atrophic, appearing thin, red, and shiny, so that perforation may threaten.

These hernias are nearly always accompanied by adhesions, either between the sac-wall and the contents or between the contents themselves. The omentum especially is often very adherent, not only to the sac-wall but also to different parts of itself and to the intestine. Consequently obstruction and strangulation are very apt to occur, either through the exit of the hernia, or under bands or through holes in the omentum. Hence, in strangulated cases, the surgeon must take care not merely to reduce the contents as a whole, but to separate them, and seek for the cause of the strangulation within the contents.

Ventral Hernia.—This variety includes all hernias through the anterior abdominal wall other than umbilical and inguinal. The vast majority of ventral hernias seen nowadays are scar-hernias, and are best classified, for descriptive purposes, into scar-hernias and other varieties.

1. *Ventral Hernia other than Scar-Hernia.*—These hernias pass through openings, congenital or acquired, in or near the *linea alba*, *liniae semilunares*, or *liniae transversae*, especially at the junction of the last two. Since the *linea alba* is broader and thinner above the umbilicus than below, hernia is more common in the former situation, and is known as ‘epigastric hernia.’

Only during recent years has it been realized what an important *rôle* is played by *subperitoneal lipomata* in the causation of ventral hernia.[1] These lipomata originate from the subperitoneal tissue as small irregular lobulated masses of fat, and are commonest in the middle line. Such a tumour, as it grows, may follow the course of one of the blood-vessels which pass from the subperitoneal tissue through the transversalis fascia to the abdominal wall. Having reached the prefascial region it continues to develop, bringing about an increase in the size of the opening through which it has passed, and presents physical signs indistinguishable from those of ordinary omental hernia. It can be reduced through its opening and made to project again when the patient coughs ; by dragging on the peritoneum it causes pain and reflex abdominal symptoms. Sooner or later a pouch of peritoneum is drawn through the opening into the centre of the tumour, and a true hernial sac is formed, which soon acquires contents and becomes a ventral hernia.

The same process occurs in the femoral and, more rarely, in the inguinal region; it is probable that most of the cases described as lipomata in these regions are of this nature.

Ventral hernia is accompanied by many unpleasant symptoms, consisting chiefly of colicky pain and of reflex gastric and intestinal disturbance. The symptoms are aggravated by almost all movements of the body, due partly to dragging on the peritoneum and partly to constriction of the neck of the hernial opening.

2. *Scar-Hernia.*—Hernias through former laparotomy wounds account for most of the ventral hernias seen in these days of abdominal surgery. The prophylaxis has been dealt with elsewhere.

Scar-hernias generally give evidences of their appearance within six months of the operation, and tend progressively to increase in size. The hernia grows more rapidly in obese patients, because of the increased intra-abdominal pressure due to the relatively large amount of intra-abdominal fat.

The shape and size of the sacs of these hernias vary widely, according to the nature of the previous operation : in some cases the hernia comes through a small opening, such as would be left by a drainage tube ; in others, where there is a much larger weak area, the sac has no regular neck.

The sac sometimes burrows irregularly between the fascial and muscular layers of the abdominal wall and amongst the subcutaneous tissue, a point which will be further noted under operative treatment.

Obturator Hernia.—In this rare hernia, the herniated viscus, generally intestine, escapes from the abdominal cavity through the obturator canal. This osteo-fibrous canal, situated beneath the horizontal ramus of the pubis in the upper part of the obturator foramen, under normal conditions transmits only the obturator vessels and nerve.

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[1] See Stewart, *Amer. Med.*, 1905, vol. x. p. 185, and Lothrop, *Med. and Surg. Reps. of Boston City Hospital*, 1901, p. 66.

Obturator hernias are extremely rare; for this reason, most of the cases are recorded, and only about 200 are to be found in medical literature. Most of the cases have occurred in elderly females; the greater capacity and greater transverse diameters of the female pelvis would appear to favour their occurrence in women.

The sac passes downwards, forwards, and inwards along the outer part of the horizontal ramus of the pubes, and usually proceeds over the obturator externus muscle and beneath the pectineus and adductor longus; sometimes the sac passes beneath the obturator externus and lies between this muscle and the obturator membrane. The obturator vessels and nerve lie to the outer side of the neck of the sac.

The hernia is usually of small size and is seldom recognized except when strangulated, and even then is more liable to be first recognized in the course of an operation for acute intestinal obstruction than diagnosed apart from operation. What is known as Howship-Rhomberg's symptom consists of pain and paraesthesiae in the skin over the inner aspect of the thigh and knee, and is caused by pressure of the hernia on the obturator nerve. When of larger size, the hernia forms a swelling in the innermost part of Scarpa's triangle, near the origin of the adductor muscles. In rare cases the hernia has stretched the pectineus muscle and has passed between its fibres to lie directly beneath the skin; in this situation it is easily mistaken for a femoral hernia. Vaginal examination is an important aid to the diagnosis of obturator hernia, for the internal opening of the obturator canal is readily palpable from the vagina.

Sciatic Hernia.—This is an extremely rare hernia. A complete account of the conditions may be found in a paper by Koeppl,[1] who gives details of the 23 cases recorded in medical literature. Hernia of the sciatic region may make its exit through one of three openings. It may follow the gluteal artery, leaving the great sacro-sciatic foramen above the pyriformis; it may follow the sciatic artery and leave the same foramen below the pyriformis; or it may leave the pelvis through the lower sacro-sciatic foramen. Intestine, omentum, bladder, or the uterine adnexa may be found in the sac.

Perineal Hernia.—By perineal hernia is meant the protrusion of abdominal or pelvic viscera into the ischio-rectal fossa through openings in the pelvic diaphragm. The pelvic diaphragm (Fig. 35) consists of the levator ani (pubo-coccygeus and ilio-coccygeus) and coccygeus muscles, reinforced by the pelvic connective tissue, and the hernial protrusion occurs through spaces either between the individual muscles or through the fibres of one of them.

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[1] Koeppl, *Beiträge f. klin. Chir.*, 1908, vol. lxviii. p. 314.

The term perineal hernia requires careful definition, for there is no doubt that other hernias through the pelvic floor, though not perineal hernias in the above strict definition of the term, are often wrongly classed as such. These will again be referred to. It seems hardly necessary to add that the common prolapses and protrusions through the vaginal, rectal, and urethral openings of the pelvic diaphragm are also excluded.

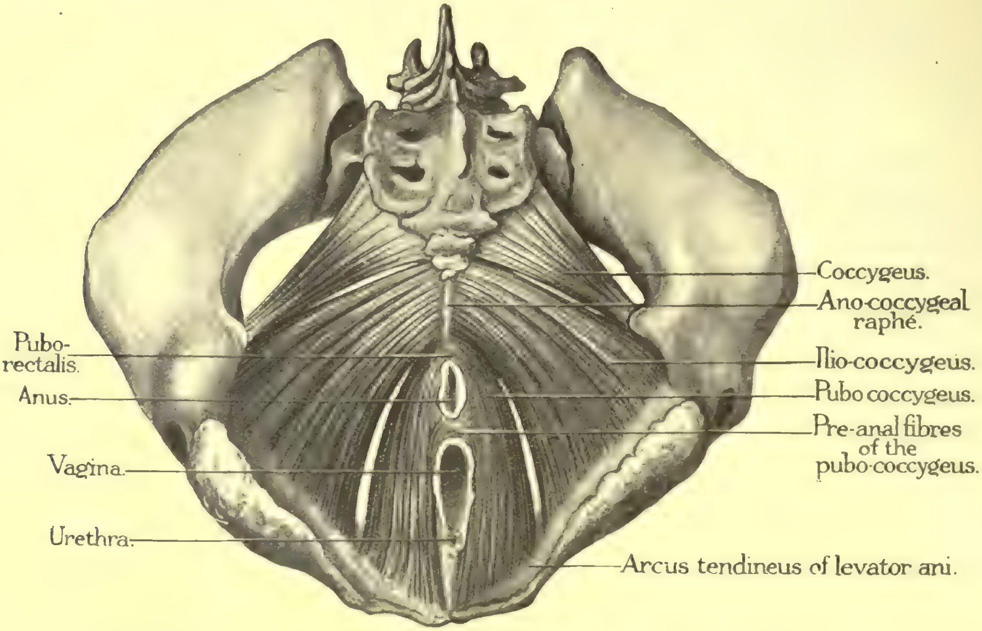

FIG. 35.—Pelvic diaphragm in the female seen from below. (After Morris.)

Perineal hernia is of great rarity. Most of the cases have occurred in women, and predisposing factors are stated to be slackness of the pelvic floor, ruptured perineum and tearing of the levator ani muscle from parturition, wide transverse pelvic outlet and decreased pelvic inclination, and unusual length of the mesentery.

More specific predisposing factors are abnormal muscular clefts in the pelvic diaphragm and peculiarities in the arrangement of the pelvic peritoneum, both probably of congenital origin. Both these factors have been investigated by Ebner[1] and Zuckerkandl.[2] The principal clefts in the pelvic diaphragm occur between the fibres of the levator ani muscle, between the pubo-coccygeus and the ilio-coccygeus, or between the ilio-coccygeus and coccygeus. The arrangement of the pelvic peritoneum favouring hernia consists in abnormal depth of the pouch of Douglas; in the embryo and foetus this pouch is deeper than in the adult, and the embryonic condition occasionally persists throughout adult life. Congenital diverticula in the pelvic peritoneum have been often sought but never found. In nearly all the cases described in women, the hernial opening has been situated in the peritoneal pouch between the uterus and rectum; a few cases are reported where the opening occurred anterior to the broad ligament.

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[1] Ebner, *Deutsche Zeitschr. f. Chir.*, 1887, Bd. xxvi. S. 48.

[2] Zuckerkandl, *Deutsche Zeitschr. f. Chir.*, 1891, Bd. xxxi. S. 590.

After the hernial protrusion has escaped through the pelvic diaphragm and has reached the loose areolar tissue of the ischio-rectal fossa it seldom remains stationary but tends progressively to increase and to advance in various directions. According to the situation in which it makes its external appearance, it receives its name.

If it advances directly downwards it comes to lie under the skin, usually to one side of the middle line, and becomes an 'ischio-rectal hernia.' If it advances in an anterior direction it becomes an 'anterior perineal hernia,' and causes a protrusion of the skin near the vulva (Fig. 36); it may bulge forward the posterior vaginal wall, becoming a 'posterior vaginal hernia'[1]; or it may appear as a swelling protruding from the vagina, when it is sometimes known as a 'prolapse hernia of the vagina.' If it advances in a posterior direction, it becomes a 'posterior perineal hernia,' forming a swelling under the skin in the neighbourhood of the anus. It may bulge into the rectum forming a 'rectal hernia,' and may cause a protrusion of the bowel from the anus, when it is known as a 'prolapse hernia of the rectum.'

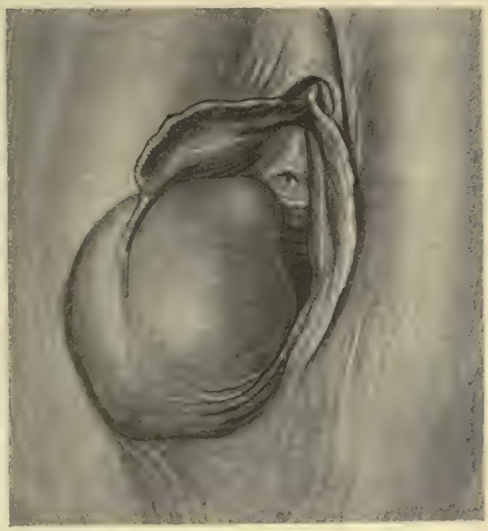

FIG. 36.—Perineal hernia. (Kelly.)

Perineal hernia must be diagnosed from cystocele, rectocele, vaginal cysts, pelvic abscess, and uterine polypi.

Besides congenital clefts, two other defective conditions of the pelvic diaphragm have been met with, leading to perineal hernia.

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[1] An illustration of this variety of hernia will be found in the Article on Prolapse (Vol. II. p. 650, Fig. 337).—EDITORS.

The first of these is a primary atrophy or dystrophy of the levator ani muscle; perineal hernia in association with this condition is analogous to congenital prolapse of the uterus sometimes accompanying spina bifida. Such a case has been reported by Exner.[1] The patient was a virgin aged 36 who, shortly after a heavy fall on the buttock, developed a swelling in front of, and to one side of the anus. The hernial opening was readily found, by combined perineal, rectal, and vaginal palpation, to admit three or four fingers. At the operation the exceedingly thin and atrophic levator ani muscle was found stretched over the hernial sac; there was no penetration of the muscle by the sac, but a general bulging. The hernia was returned into the pelvis and the defect in the pelvic diaphragm made good by turning in a flap of gluteus maximus muscle and securing it to the structures covering the descending pubic ramus. The congenital nature of the case was confirmed by the X-ray demonstration of defective development of the fourth sacral vertebra.

The second is due to the presence of fibrous or fatty tumours growing from the ischio-rectal fossa; by upward pressure they displace the fibres of the levator ani and stretch the peritoneum; when removed they leave a cleft in the muscle and a hernial sac develops.

Two such cases in women are described by Bakay,[2] and Lynn [3] has reported one in a man. One of Bakay's cases was a woman of 25, in whom he removed a large lipoma of the buttock. In a few days another tumour appeared in the same place, which proved to be a hernial sac containing small intestine; the hernial opening was in the levator ani between the ischial tuberosity and the anus. His second case was almost similar.

Other Hernias of the Pelvic Floor.—Certain other rare and peculiar hernias, which are not strictly perineal, though sometimes described as such, can pass through the pelvic floor.

One of these is the 'anterior vaginal hernia,' which does not reach the ischio-rectal fossa, but escapes directly towards or into the vagina by separating the vesico-uterine tissues. In this connection it must be pointed out that a hernia may separate the vesico-uterine tissues and then make its way laterally through the levator ani, thus reaching the ischio-rectal fossa. Hunner[4] mentions that he has operated on such a case.

Von Winckel[5] points out that sites of abnormal yielding may occur in that part of the pelvic floor anterior to the transversus perinei muscle, in the space bounded by the latter muscle and the ischio-cavernosus and bulbo-cavernosus (Fig. 37). To hernias of this region he gives the name anterior and posterior subpubic hernia, and points out that they are not true perineal hernias ; he suggests that the term perineal hernia should be restricted to hernias occurring through the pelvic floor posterior to the transversus perinei muscle.

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[1] Exner, *Archiv f. klin. Chir.*, 1912, vol. xcviii. S. 897.

[2] Bakay, quoted by Exner.

[3] Lynn, *Lancet*, 1897, p. 191.

[4] Hunner, in *Gynaecology and Abdominal Surgery*, Kelly-Noble, 1910, vol. ii. p. 690.

[5] Von Winckel, *Samml. klin. Vorträge*, n.f. No. 397; *Gyn.*, No. 146.

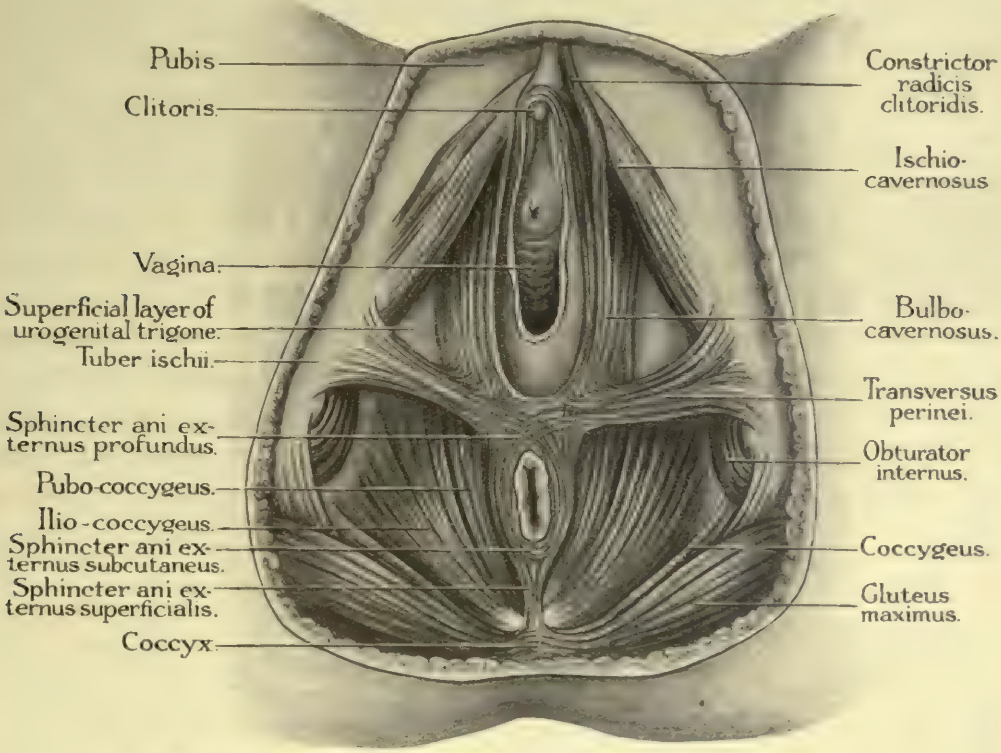
Pubis
Clitoris
Vagina
Superficial layer of urogenital trigone
Tuber ischii
Sphincter ani externus profundus
Pubo-coccygeus
Ilio-coccygeus
Sphincter ani externus subcutaneus
Sphincter ani externus superficialis
Coccyx
Constrictor radicis clitoridis
Ischio-cavernosus
Bulbo-cavernosus
Transversus perinei
Obturator internus
Coccygeus
Gluteus maximus

FIG. 37.—Muscles of the vulval and perineal region. (After Morris.)

HERNIA OF THE INTERNAL GENERATIVE ORGANS

Hernia of the female internal generative organs is by no means uncommon, and there is no doubt that its frequency has been, and still is, underestimated. Isolated cases are still published as rarities, and the whole subject has often been the object of literary research. Carmichael[1] states that the uterine adnexa may be expected to be found in over 60 per cent of cases of inguinal hernia in young babies, and in 25 to 30 per cent of cases in children up to twelve years of age.

The relative frequency with which the different organs have been found in hernial sacs, in published cases, is stated thus by Andrews :[2]

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[1] Carmichael, *loc. cit.*

[2] Andrews, *Journ. Amer. Med. Assoc.*, 1906, vol. xlvii. p. 1707.

Hernia of tube without ovary	46
Hernia of ovary with tube	80
Hernia of ovary without tube (or tube not mentioned)	167
Hernia of non-gravid uterus	43
Hernia of pregnant uterus	30
	366

There is no doubt that in this list the figures for hernia of the tube or ovary alone are too high, and are at the expense of the figures for the ovary and tube together. The explanation of this is that some reporters of cases have regarded the ovary as the principal content of the sac and have not mentioned the tube. Correct figures for the relative frequency of the various organs in hernial sacs are to be got by considering only those cases which are fully and accurately reported. This has been done by Heineck[1] for all such cases reported between 1890 and 1910: he finds 110 tubo-ovarian, 85 ovarian, and 28 tubal hernias. Too much importance need not be attached to accurate classification; the majority of tubal or ovarian hernias become tubo-ovarian in process of time—the former two are a stage toward the latter. Hernias of the uterus are almost invariably accompanied by the tube or ovary or both. Cross-references are commonly found in the literature, and the fact emerges that the distinction between tubal, ovarian, tubo-ovarian, and uterine hernias is often an arbitrary one; some of them should be termed utero-adnexal hernias.

Hernias of the Tube and Ovary

The tube and ovary are by far the commonest of the internal generative organs found in hernial sacs. They are best considered together for reasons stated above. The relative frequency of tubal, ovarian, and tubo-ovarian hernias has already been mentioned. Hernia of the tube alone has been studied by Schultz,[2] Morf,[3] and Andrews,[4] and these authors have been able to collect 19, 24, and 46 cases respectively.

Variety of Hernia.—Inguinal is far the commonest. Heineck in 221 cases found 196 inguinal and 25 of other varieties; of the latter 16 were femoral, 5 obturator, 2 sciatic, 1 spontaneous ventral hernia through the lateral abdominal wall, and 1 post-operative ventral hernia through the scar of an incision for drainage of an appendix-abscess. Morf,[5] in hernias of the tube alone, found 27 inguinal, 14 femoral, and 2 obturator.

The tube and ovary may be the only contents of the sac or may be associated with other hernial contents—commonly with intestine and omentum, occasionally with the vermiform appendix, and very rarely with the urinary bladder.

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[1] Heineck, *loc. cit.*

[2] Schultz, *Thèse*, Paris, 1898.

[3] Morf, *Annals of Surg.*, 1901, vol. xxxiii. p. 247.

[4] Andrews, *loc. cit.*

[5] Morf, *loc. cit.*

The inguinal hernias may be unilateral or bilateral, and are more common on the left side; a case of direct hernia is recorded by Kivlin,[1] and 3 cases of the interstitial variety by Tubby,[2] Nicoll,[3] and Launay.[4]

The few cases of obturator and sciatic hernia of the tube and ovary merit a special note. In the 5 authentic cases of obturator hernia recorded by Heineck, the ages of the patients was 66, 68, 72, 78, and 87 years respectively. In one, the tube was the sole content of the sac; in another, in addition to the tube, the sac contained a loop of small intestine and a piece of omentum; the remaining three were tubo-ovarian hernias, and two of these, in addition to the uterine appendages of one side, contained a loop of gangrenous gut. Two of them co-existed with other hernias; the tubal hernia existing in a patient who also had a left obturator hernia of the bladder and a right femoral hernia, and one of the tubo-ovarian hernias being associated with bilateral femoral hernias.

Of the 2 cases of sciatic hernia, that of Chénieux[5] was a multipara aged 40 who presented a large tumour of the right buttock; at operation, the sac was found to contain a cystic ovary and tube, which were removed, the stump being stitched to the parietal pelvic peritoneum at the hernial opening. Woelfle's case, recorded by Koeppl,[6] also presented a tumour of the right buttock. An incision was made over the hernia and the sac isolated and opened; it was found to contain the ovary and tube, which were removed and the stump returned into the pelvic cavity. The opening was then closed by suturing the pyriformis to the lesser sacro-sciatic ligament.

Age-incidence.—This corresponds to the age-incidence of hernia in general. They are relatively frequent in the first year of life and again in the period of adult life when many of the predisposing and exciting causes become operative. In the 221 cases collected by Heineck,[7] 69 occurred in the first year, and 64 between the fifteenth and fortieth years, the greatest number of these being in the fourth decade. After the fortieth year they decline in number and are relatively rare towards the extreme of life. Carmichael[8] in his series of cases of inguinal hernia in young children found that, in 21 cases under one year of age, the adnexa were present in 13; in 21 cases under five years, in 7; in 34 cases under twelve years, in 2.

Etiology.—This is the same as for female hernias in general, but there are a few points worthy of special mention. The majority of adnexal hernias are congenital and a persistent canal of Nuck stands out as the chief etiological factor. Carmichael and others point out that the peritoneum forming this canal belongs to the peritoneal area entering into the formation of the broad and infundibulo-pelvic ligaments, which would account for the frequency with which tubo-ovarian hernia is found in early life. In two of his cases the infundibulo-pelvic ligament only was in the sac ; he found that the tube and ovary, if lying low in the sac, could not be reduced into the abdominal cavity until this peritoneal attachment was divided.

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[1] Kivlin, *New York Med. Journ.*, 1908, vol. lxxxviii. p. 404.

[2] Tubby, *loc. cit.*

[3] Nicoll, *Glasgow Med. Journ.*, 1905, vol. lxiv. p. 268.

[4] Launay, *Bull. de la Soc. Anat. de Paris*, 1897, vol. xi. p. 78.

[5] Chénieux, *Bull. et Mém. de la Soc. Chir. de Paris*, 1890, vol. xvi. p. 396.

[6] Koeppl, *Beiträge f. klin. Chir.*, 1908, vol. lxiii. p. 314.

[7] Heineck, *loc. cit.*

[8] Carmichael, *loc. cit.*

The analogy between hernia of the ovary into the inguinal canal and descent of the testicle is a tempting one, but a false. In many cases of tubo-ovarian hernia the round ligament on the affected side is extremely short, and for this reason it has been sought to make the shortness of the round ligament responsible for the descent of the ovary. Its shortness may of course be either primary or secondary, and this is a point upon which observers are not agreed. Obviously, the round ligament cannot pull on the ovary except indirectly by way of the uterus and ovarian ligament. The only reasonable way the round ligament can be supposed to facilitate descent of the ovary into a hernial sac is by pulling the uterus to the side of the pelvis and allowing the ovary to approach the internal abdominal ring.

Abnormal length of the broad, infundibulo-pelvic, or ovarian ligaments, congenital or acquired by repeated pregnancies or puerperal subinvolution, is an important etiological factor according to many observers. Lockwood [1] considers excessive length of the ‘ mesentery of the ovary ’ the chief cause of ovarian hernia.

In a small percentage of cases adnexal hernias are associated with malformations of the internal and external genitalia. Absence of the uterus, rudimentary uterus, bicornute and bipartite uterus, unilateral absence of ovary or tube or both, absence of vagina, and imperforate hymen have all been noted.

In cases of pseudo-hermaphroditism the association in hernial sacs of a Fallopian tube or uterus with a testicle is not uncommon. This aspect of the subject needs no further mention here, beyond recalling the fact that in some supposed cases of ovarian hernia, microscopical examination of the herniated organ has proved it to be a testicle.

Pathological Changes in the Herniated Tube and Ovary.—From his close study of a large number of cases, Heineck [2] concludes that the displacement of a tube or ovary into a hernial sac, where they are exposed to circulatory disturbances and slight traumatisms, is unfavourable to their anatomical and functional integrity.

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[1] Lockwood, *Brit. Med. Journ.*, 1896, No. 1.

[2] Heineck, *loc. cit.*

This, no doubt, is true for congenital more than for acquired cases. Apart from functional disturbances, the herniated tube and ovary have frequently been found to present grossly pathological conditions.

1. *Strangulation.*—This complication is by no means uncommon and can occur at any age, irrespective of the type of hernia or of the hernial contents. Of the strangulated inguinal hernias the majority are congenital; strangulation of femoral hernias is relatively common, occurring in about one-half the recorded cases (Heineck); two strangulated obturator hernias have been described (Gusenthal,[1] Schopf[2]). Morf, in his series of 24 cases of tubal hernia, found strangulation recorded in 14; of these 6 were inguinal, 7 femoral, and 1 obturator. The tube and ovary undergo the usual characteristic changes, becoming engorged and swollen, and ultimately black and gangrenous; as associated hernial contents, intestine and omentum are not uncommon. References to all reported cases of strangulated tubal, ovarian, and tubo-ovarian hernia up to 1910 are to be found in Heineck's paper.

2. *Torsion.*—This complication is not of unusual occurrence. Heineck has collected 5 cases in which it occurred in ovarian hernia, and 18 in tubo-ovarian hernia. Torsion of the pedicle seems to be confined to congenital inguinal hernia, and nearly all the cases have occurred in infants under one year old. Torsion is favoured by the great mobility of the tube and ovary, and by the slenderness of the pedicle at this period of life; the pedicle may be twisted to any extent, from a half turn to several complete twists. The changes produced, if the condition is unrelieved, are ultimately the same as those produced by strangulation; gangrene frequently results. The symptoms are the same as those of strangulated hernia.

3. *Infection.*—Acute and chronic infections of the herniated tube have been found. The complication does not seem to be a common one, though there is no reason why the tube should not be just as liable to infection when herniated as when normally placed. Suppurative salpingitis (Morf,[3] Le Nouene[4] and others). Pyosalpinx (Léjars,[5] Goepel,[6] Guinard and Dudefoy,[7] and others), chronic inflammatory changes with adhesion between the tube and the sac, have all been recorded. Walther[8] found, in an inguinal hernial sac, a hydrosalpinx developing from an accessory Fallopian tube. Morf's case is of great interest, in that the development of infection

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[1] Gusenthal, *Wiener med. Presse*, 1893, vol. xxvi. p. 1010.

[2] Schopf, *Wiener klin. Wochenschr.*, 1903, vol. xvi. p. 207.

[3] Morf, *loc. cit.*

[4] Le Nouëne, *Gaz. de Gyn.*, 1903, vol. xviii. p. 337.

[5] Léjars, *Revue de Chir.*, 1893, vol. xiii. pp. 12, 111.

[6] Goepel, *Zentralbl. f. Chir.*, 1896, vol. xxiii. p. 829.

[7] Guinard and Dudefoy, *Bull. de la Soc. Anat. de Paris*, 1893.

[8] Walther, *Zentralbl. f. Chir.*, 1897, vol. xxiv.

of the tube could be watched whilst the patient was under observation. The patient had a congenital inguinal hernia. A few days after the onset of acute vaginitis, the hernia became irreducible, painful, and swollen; at operation the sac contained pus and an acutely inflamed tube imbedded in a mass of omentum. Two cases of tuberculosis of the herniated tube have been described (Pitt-Taylor[1] and Mencière[2]).

4. *Pregnancy.*—Two cases of tubal pregnancy in an inguinal hernia have been recorded. In one (M. Jordan[3]) the pregnant tube aborted, and the ovum and much blood lay amongst loops of intestine in a left inguinal sac; there was a history of seven weeks' amenorrhea followed by the usual symptoms of pain and uterine haemorrhage. In the other (Carl Beck, quoted by Heineck) the pregnant tube ruptured.

5. *Neoplasms.*—Several cases of neoplasm of the herniated ovary have been described, amongst these being multilocular and unilocular cysts (Biermer,[4] Nicoll,[5] Wahl,[6] Fargas,[7] Parsche[8]), fibroma (Way[9]), and spindle-celled sarcoma (Seymour[10]). Parovarian cysts have twice been found associated with tubo-ovarian hernia (Aue,[11] Bolt[12]).

Hernia of the Uterus

From its position in relation to the hernial orifices and from its firm attachments, it is only natural that the uterus should be less commonly found in a hernial sac than the tube or ovary. It is obvious that the uterus can seldom, if ever, find its way into a hernial sac unaccompanied by the tube or ovary: 'utero adnexal hernia' is hence a more correct term than 'uterine hernia' or 'hysterocele.' Though the uterus may be found as the primary content of a congenital hernial sac at birth, it is more usually a secondary one; a small hernia which, in its early stages, contains the tube or ovary alone, may, if allowed to persist and to increase in size, gain the uterus as an additional content. From these considerations the difficulty of accurately labelling any particular genital hernia is apparent, and the numerous cross-references in the literature are readily explained. The exact name will depend on the point of view of the particular operator, who may attach especial importance to one or more of the organs in the sac, and will label the hernia thereby. As an example to illustrate cross-references, in Heineck's[1] list of adnexal hernias, the uterus was present in 16, and in Küstner's[2] list of uterine hernias, 5 are found in Heineck's list of adnexal hernias.

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[1] Pitt-Taylor, *Brit. Med. Journ.*, 1899, vol. ii. p. 853.

[2] Mencière, *Revue mens. des maladies de l'enfance*, 1897, vol. xv. p. 270.

[3] Jordan, *Münch. med. Wochenschr.*, 1897, vol. xliv. p. 7.

[4] Biermer, *Zentralbl. f. Gyn.*, 1897, vol. xxi. p. 233.

[5] Nicoll, *loc. cit.*

[6] Wahl, *Monatsschr. f. Geb. u. Gyn.*, 1901, vol. xiii. p. 643.

[7] Fargas, *Arch. f. Tocologie*, 1890, vol. xvii. p. 767.

[8] Parsche, *Internat. Journ. of Surg.*, 1906, vol. xix. p. 299.

[9] Way, *Austral. Med. Gaz.*, 1893, vol. xii. p. 191.

[10] Seymour, *Medical News*, 1897, vol. lxx. p. 241.

[11] Aue, *Zentralbl. f. Gyn.*, 1892, vol. xvi. p. 698.

[12] Bolt, *Surg., Gyn., and Obstets.*, 1908, vol. vi. p. 296.

Inguinal Hernia.—Hernia of the uterus is usually of the inguinal variety, of which up to 1910 it is possible to collect 35 fully reported cases ; 21 of these are to be found in Küstner's list, 3 additional ones are given by Birnbaum,[3] and Heineck includes 11 others in his list of adnexal hernias.

Etiology.—The majority of cases are congenital, in the sense that the hernia existed at birth ; a few are no doubt acquired. In congenital cases the important etiological factor is a persistent canal of Nuck, as has already been described under tubal and ovarian hernias. The tube and ovary are generally the primary contents of the sac, the uterus being drawn in secondarily ; this view is justified by the facts that the adnexa are found in hernial sacs far more commonly than the uterus, and that in every case of uterine hernia at least one ovary is also present.

Malformations of the internal genitalia are common and existed in 8 of the 10 non-pregnant cases in Küstner's list ; the shortening of the round ligament, noted in so many cases, may be primary or secondary. The analogy between the round ligament and the *gubernaculum testis* is of interest, but it is uncertain how far the round ligament is responsible for dragging the uterus through or near the inguinal ring. In cases of male pseudo-hermaphroditism, when a uterus is present, it is relatively common to find it in an inguinal hernial sac. A full account of this aspect of the subject is given by Neugebauer,[4] who collected 103 cases and found that in 14 of them the uterus occupied an inguinal sac in company with a testicle.

Diagnosis.—There are usually no symptoms peculiar to the presence of the uterus ; most of the cases have been unsuspected before operation. In three (Olshausen and Leopold,[5] and Scanzoni[6]) a correct diagnosis was made by bi-manual palpation. The absence of the uterus on bi-manual palpation, in the presence of a hernia, is suggestive ; the case of a bicornute uterus with one horn in the pelvis and the other in the hernia, presents special difficulties. During menstruation the hernia may swell painfully. The diagnosis is, as a rule, obvious in the event of pregnancy.

Pregnancy in the herniated Uterus.—Pregnancy can occur in the herniated organ ; in 11 of Küstner's 23 cases of inguinal hernia the uterus was pregnant. Eisenhardt[7] reports a case in which one horn of a five months' pregnant bicornute uterus occupied the inguinal canal. Pregnancy seems to be a serious complication; of Küstner's cases, 1 ended in abortion, 2 in premature labour, in 4 Caesarean section was performed with three deaths, in 1 the uterus was removed, and in 1 herniotomy, followed by reduction, was performed. Reduction of the pregnant herniated organ by taxis has never succeeded.

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[1] Heineck, *loc. cit.*

[2] Küstner, *Handbuch d. Gyn.*, J. Veit, 1907, vol. i.

[3] Birnbaum, *Berlin. klin. Wochenschr.*, 1905, No. 21, p. 632.

[4] Neugebauer, published in book-form by Spohr, Leipzig, 1904.

[5] Olshausen and Leopold, *Archiv f. Gyn.* vol. i. S. 41.

[6] Scanzoni, *Scanzoni's Beiträge*, 1873.

[7] Eisenhardt, *Archiv f. Gyn.*, 1885, vol. xxvi. p. 439.

The best method of treatment, in the early months, is an attempt at reduction by taxis; if this is unsuccessful, induction of abortion or herniotomy are the alternatives. In the later months, reduction by taxis is still less likely to succeed; induction of premature labour or Caesarean section, followed by reduction or hysterectomy, as the case may demand, are the methods of choice.

Other Uterine Hernias.—Two cases of femoral hernia of the uterus have been published (Boivin and Dugés,[1] Lallemont [1]), and a not inconsiderable number of cases of the pregnant uterus occupying a ventral or umbilical hernial sac. True ventral hernia, with a definite hernial orifice and sac, must be distinguished from the common event, in no wise a hernia, of projection of the pregnant uterus between separated recti muscles—the so-called 'pendulous belly.'

In the case of a ventral hernia the uterus can only find its way into the sac in the later months of pregnancy, when the abdomen becomes markedly pendulous. Reduction is as a rule easy, and an abdominal belt is usually efficient in preventing recurrence. In Tipjakow's [2] case taxis failed, and reduction was affected by operation. In Rosanoff's [3] case, taxis was unsuccessful, and the patient had a full-term natural labour; ten weeks after labour operation was performed and the uterus removed, because the bulk of even the empty uterus was an obstacle to the apposition of the sides of the hernial opening. Other cases are fully reported by Anderson [4] and Schauta.[5] In Adams' [6] paper, details of 4 cases of umbilical and 8 of ventral hernia of the pregnant uterus, published prior to 1889, are to be found.

OPERATIVE TREATMENT

Inguinal Hernia

Every operation for the cure of inguinal hernia consists of two steps (1) the treatment of the sac, (2) the closure of the inguinal canal. In the male sex the operation is complicated by the presence of the spermatic cord; in the female sex the round ligament is a comparatively unimportant structure and its presence may be neglected. The radical cure of inguinal hernia, therefore, presents fewer surgical problems in women than in men, and it is not necessary to describe in detail the many methods of closing the canal, most of which have been devised to meet the twofold problem, in the male sex, of securing efficient closure of the canal and, at the same time, avoiding injurious pressure on the cord and its accompanying blood-vessels. The more important modifications in the treatment of the sac will be described, but only one method for closing the canal.

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[1] See Küstner's article.

[2] Tipjakow, *Medicinskoje Obesrenge*, 1895, Nr. 17 (quoted by Küstner).

[3] Rosanoff, *Archiv f. klin. Chir.*, vol. xlix. p. 918.

[4] Anderson, *Ann. of Gyn. and Pediatry*, Boston, vol. xiii. p. 111.

[5] Schauta, *Lehrbuch d. gesamt. Gyn.*, 1897, vol. i. p. 340.

[6] Adams, *Amer. Journ. of Obstets.*, 1889, vol. xxii.

Treatment of the Sac. — Complete obliteration of the sac is essential; not even a dimple must be left at the neck of the sac, otherwise the hernia will recur however efficiently the canal may have been dealt with. Furthermore, the sac must be completely removed from the canal; to leave even a small part of it means the interposition of a piece of tissue between the walls of the canal, leading to their imperfect apposition and union.

The following are the chief methods employed for dealing with the sac, and the first is the one generally to be preferred.

(*a*) *Ligature and Removal of the whole Sac, and Displacement of the Stump.*—After the sac has been cleaned from its coverings and emptied of its contents, a needle threaded with a ligature is made to transfix the peritoneum just above the neck of the sac. The ligature is then tied on each side, the ends being left long, and the sac cut away. The peritoneum above the internal ring is separated from the muscles with the finger, and the ends of the ligature are passed through the muscles, from behind forwards, and tied at a point well above the internal ring, so as to drag the stump of the sac well away from the hernial orifice (Fig. 38).

This very efficient method entails certain precautions if it is to succeed. In the first place the neck of the sac must be removed completely, and to do this it is best to split up the external oblique to a point above the hernial orifice. In the second place it is important to see that none of the contents are adherent to the neck of the sac or protrude through it, otherwise they may be injured. Thirdly, the neck of the sac must be carefully cleared; neglect of this precaution has led to inclusion of a portion of the bladder in the ligature.

(*b*) *Torsion of the Sac.*—After cleaning the sac and opening it to ensure the complete emptying of its contents, its fundus is grasped by forceps and twisted up tightly, the neck being steadied between the thumb and forefinger. Previous to twisting, a bed has been made for its reception by separating the peritoneum above the internal ring from the transversalis muscle. The twisting is continued until the sac begins to form itself into a knot, when the forceps are pushed up into the bed previously prepared and the twisted sac left there. By this method the neck of the sac can be completely obliterated without any risk of injuring the bladder or other structures.

(*c*) *Kocher's Method.*—After the sac has been cleaned and freed from its contents, the finger is passed up in front of it through the canal to a point above the hernial opening. A long pair of forceps is then pushed through the muscles on to the finger-tip and guided down to the external ring, where the fundus of the sac is seized and drawn up through the opening in the muscle. The sac is then laid down upon the muscle over the canal and stitched in place.

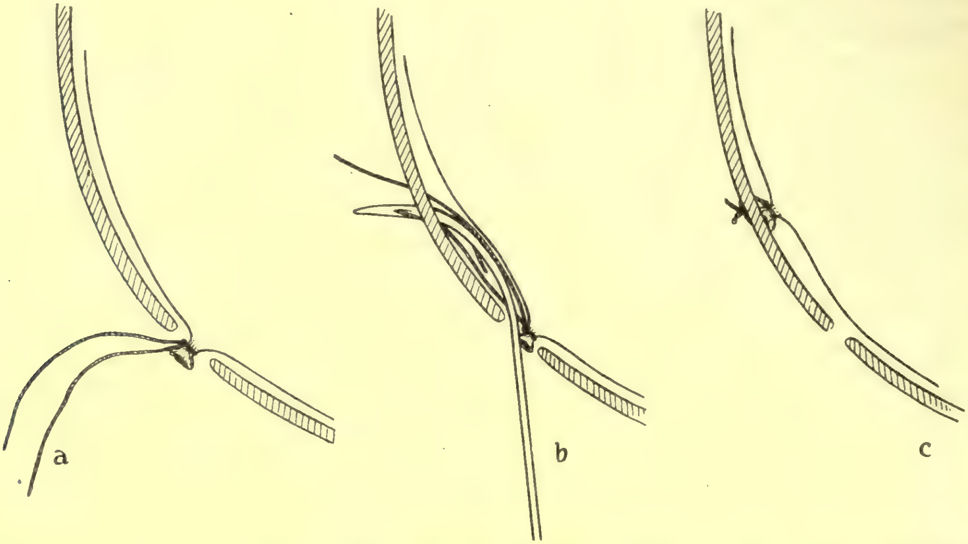

FIG. 38.—In *a* the neck of the sac has been ligatured, and the sac itself cut away; *b* and *c* show how the ends of the ligature around the neck of the sac are passed through the abdominal walls, so that when they are tied the stump is displaced. (After Cheyne and Burghard.)

(*d*) In *MacEwen's method* the whole length of the sac, from the fundus to a point above its neck, is pursed up with a silk suture; the ends of the suture are left long and are carried through the muscles opposite the hernial opening in much the same manner as in the first described method. The sac thus forms a fixed pad over the hernial opening.

In direct herniae, where there is usually no narrow neck, the sac cannot be twisted up or ligatured; in such cases it is best to cut the sac away and unite the edges of the peritoneum.

Closure of the Canal.—Since there is no important structure in the inguinal canal, this step in the operation is in women reduced to one of great simplicity. The canal should be closed in all cases by suturing the lower arched fibres of the internal oblique and the conjoined tendon to Poupart's ligament.

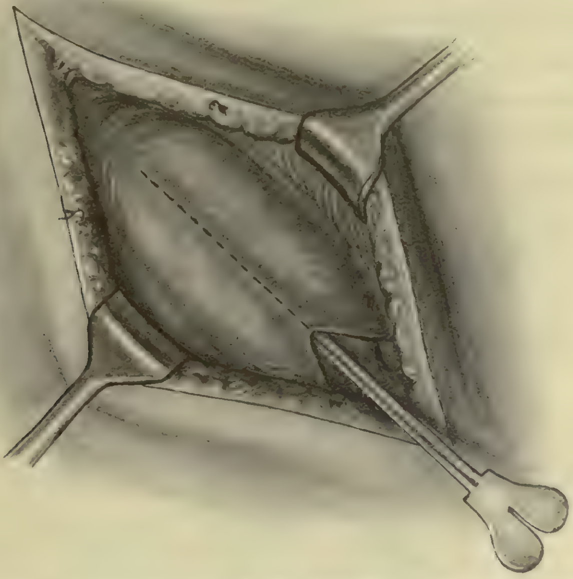

FIG. 39.—Grooved director passed into the canal, lifting up external oblique aponeurosis. (After Kelly and Noble.)

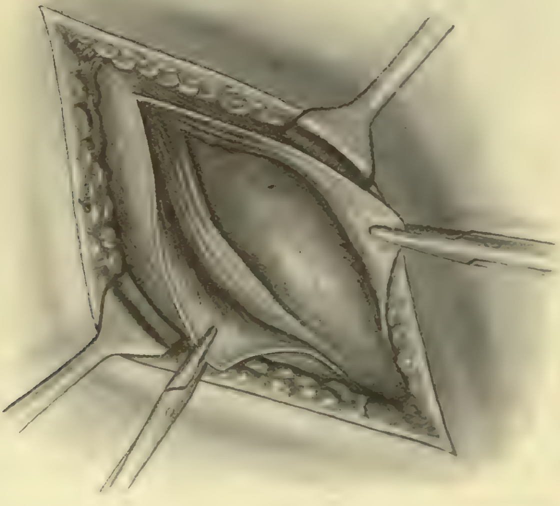

FIG. 40.—External oblique aponeurosis slit up: sac exposed. (After Kelly and Noble.)

The Operation.—The following are the steps of the operation recommended for the radical cure of an inguinal hernia in women (see Figs. 39-44).

A curved incision, convex upwards, is made in the skin, with its lower end near the symphysis pubis and its upper end near the centre of Poupart's ligament. The curve must be a large one, so as to get a thorough exposure of the whole length of the canal. The skin-flap is dissected from the external oblique and turned downwards, when the external ring and whole length of the inguinal canal will be found exposed. The pillars of the external ring are now cleaned and defined, the finger, or a grooved director, is passed into the canal between the muscles, and the external oblique aponeurosis is slit up beyond the internal ring. The sac is now identified and cleaned, care being taken to define the neck clearly. The sac is next opened and its contents inspected; any adhesions there may be between the sac and its contents are broken down or divided between ligatures; and care is taken that all the contents are returned through the hernial opening.

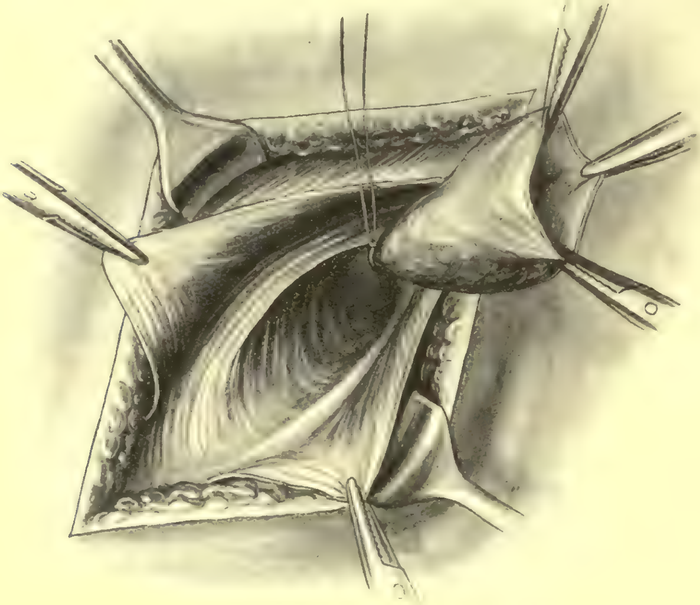

FIG. 41.—Sac opened and neck ligatured. (After Kelly and Noble.)

The peritoneum at a point immediately above the neck of the sac is then transfixed with a sharp pedicle needle carrying a silk ligature of medium thickness, the ligature is tied on both sides, the ends of the ligature being left long, and the sac is removed. The ends of the ligature are next passed through the muscles from within

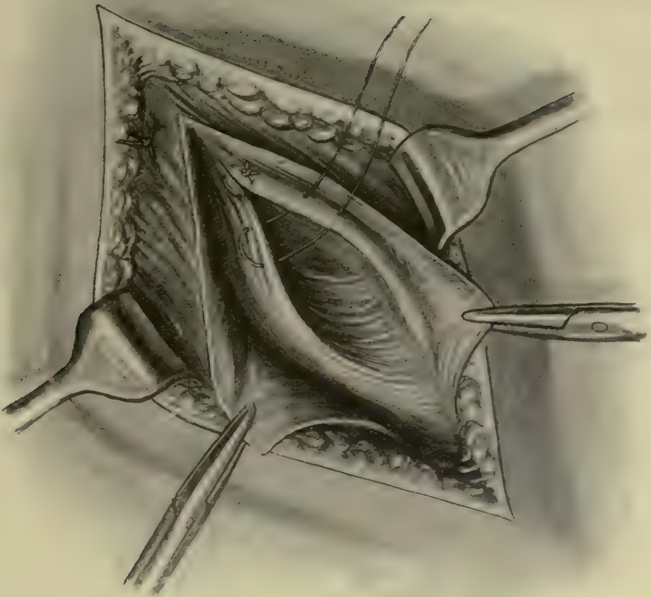

FIG. 42.—The sac has been removed and the ends of the ligature have been passed through the muscles at a point above and external to the internal ring and tied. Commencing closure of canal by mattress-sutures uniting lower edges of internal oblique and transversalis muscles to Poupart's ligament.

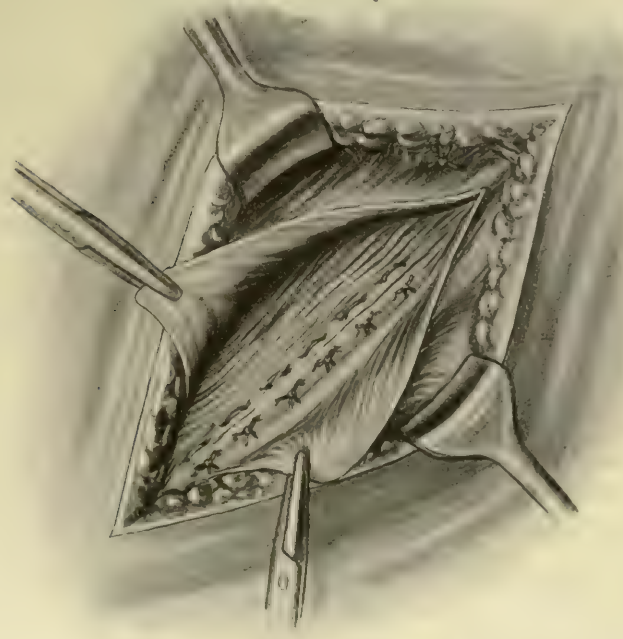

FIG. 43.—Canal completely closed.

outwards, at a point about one inch above and outside the internal ring, and tied firmly in place, with the result that the stump is displaced well away from the ring.

The next step consists in closing the canal. The lower edges of the transversalis and internal oblique muscles and the conjoined tendon are cleaned and defined, especially the posterior surface of the latter. Mattress-sutures are employed to unite the lower edges of the muscles to Poupart's ligament ; four or five sutures are necessary, the upper one completely closing the internal ring and the lower one passing through the conjoined tendon. Care must be taken to avoid injuring the bladder when passing the last suture ; this accident may happen unless the posterior surface of the conjoined tendon has been carefully defined. The edges of the divided external oblique aponeurosis are united by interrupted sutures, and the external ring may be completely closed. All bleeding points are secured and the skin-incisions united by continuous suture. The dressing is kept in place by a firm spica-bandage, and the patient should remain in bed for three weeks.

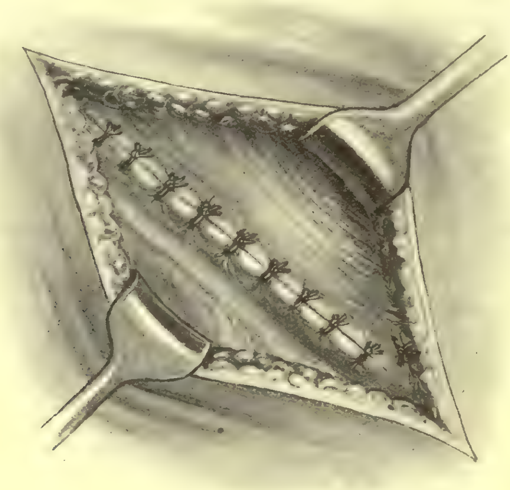

Fig. 44.—Edges of divided external oblique aponeurosis united.

Femoral Hernia

It is apparent from the literature on the subject published during recent years that the ideal method of radical cure of this form of hernia has still to be found. Besides the complete removal of the sac, an essential feature of the operation is the firm closure of the crural canal, and many ingenious methods of doing this have been devised. The sac is exposed by a vertical incision over the course of the crural canal. When distended by its contents the sac is easily identified, but when empty it often lies in the midst of a projecting fatty mass and is difficult to find. Reference has already been made to the presence of a hernial sac in the base of a subperitoneal lipoma which has found its way through the crural canal and has continued to grow amongst the tissues in the front of the thigh. After the sac has been cleaned it is opened and emptied of its contents, any adhesions being dealt with in the usual way; the neck is then transfixed and ligatured and the sac is removed. It is best to have the ends of the ligature long and to pass them through the abdominal muscles above and outside the crural ring, so that when the ends are tied the stump may be pulled well away to one side. The closure of the crural canal is next proceeded with. There are various methods of doing this and the one which appears best adapted to the needs of the particular case must be selected.

Only the principal methods in use will be described, and they fall under two headings: (1) those which aim at occluding the canal at its upper end, *i.e.* the crural ring; (2) those in which the canal is mechanically plugged, for example, by a flap of muscle and fascia, by a bone-plate, or by a silver-filigree.

In the great majority of cases, where the crural canal is small and well-defined, it will suffice to close its upper end by sutures passed through the inner end of Poupart's ligament and deeply through the fascial fibres covering the horizontal ramus of the pubis. For this purpose the needle must be carried through the tissues down to the bone and not merely through the fascia covering the pectineus muscle.

Coley[1] uses a slight modification of Cushing's method of obliterating the upper end of the canal by a suture which brings the floor of the canal in apposition with the roof, and describes his operation as follows:

> An oblique incision is made one-quarter to one-half inch below Poupart's ligament and parallel with it, almost identical with the incision made for inguinal hernia, only slightly lower and a little shorter. The sac with the mass of extraperitoneal fat that almost always surrounds it is then freed well up into the femoral opening. The masses of fat are carefully removed, the sac itself, by gentle traction, is brought down well beyond its neck to a point where it widens into the general peritoneal cavity. It is always opened before ligature, to make sure that it is empty. If omentum is present, this is tied off and removed. The ligature having been placed well beyond the neck by transfixion, it is carefully tied and the sac removed. When the stump of the sac has been pushed through the opening into the abdominal cavity, there is no longer any funicular process present in the femoral region. With a curved Hagedorn needle, threaded with kangaroo tendon, of medium size, the suture is placed as follows: The needle is first passed through the inner portion of Poupart's ligament or the roof of the canal, then downward, taking firm hold

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[1] Coley, "The Radical Cure of Femoral Hernia," *Annals of Surg.*, 1906, vol. xliv. p. 519.

of the pectineal fascia and muscle, then outward through the fascia lata overlying the femoral vein, and finally upward, emerging through the roof of the canal about one-quarter inch distant from the point of entrance (Fig. 45). On tying this suture, the floor of the canal is brought into apposition with the roof, and the femoral opening is completely obliterated (Fig. 46). The skin and superficial fascia are closed by means of an interrupted catgut suture and a sterile dressing is applied, without drainage.

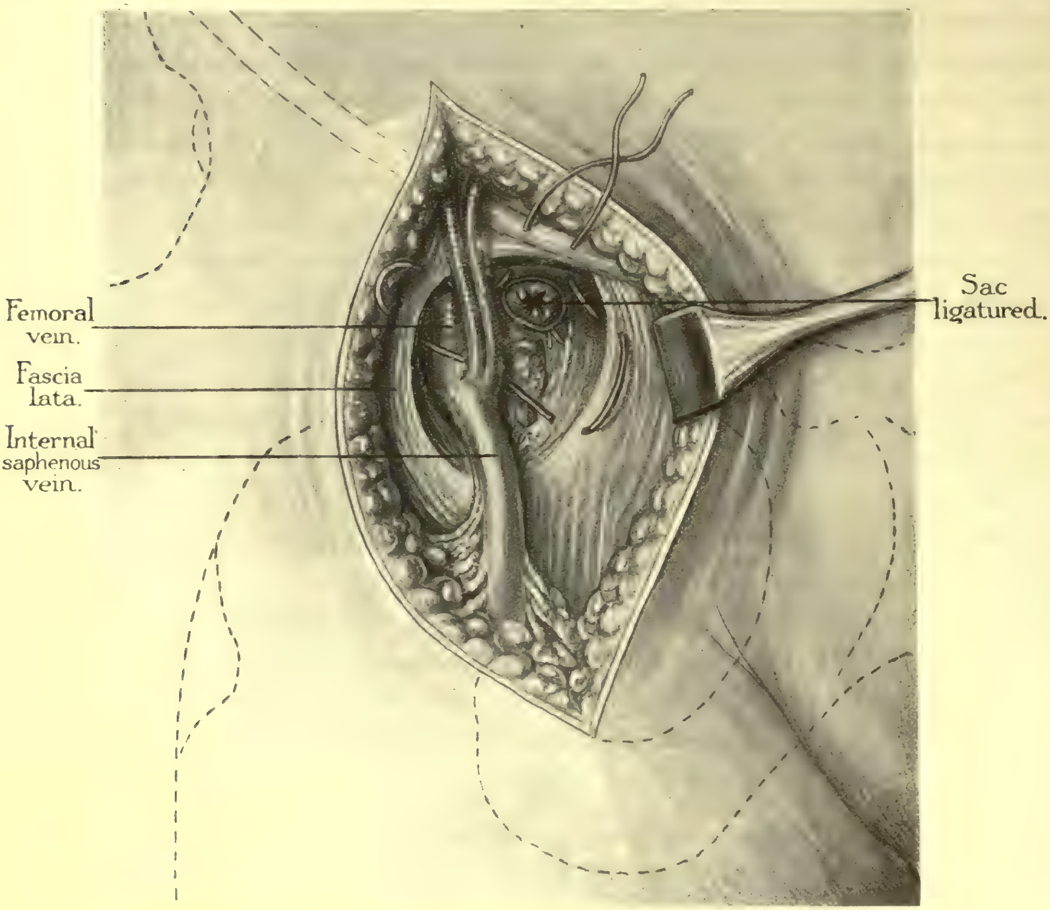

Fig. 45.—Cushing's operation for radical cure of femoral hernia. (After Kelly and Noble.)

Roux's method consists in the use of a small steel staple to fix Poupart's ligament to the ilio-pectineal line. The method is thus described by Watson Cheyne and Burghard:[1]

After the sac has been ligatured and stitched up to the abdominal wall, a finger is introduced into the crural canal and a staple is thrust through Poupart's ligament, and, guided by the finger in the canal, is fixed against the ilio-pectineal line. The staple is then driven firmly home by means of a staple-punch and a hammer, and Poupart's ligament is thus firmly attached to the front aspect of the bone and the canal thereby closed. Good results have been obtained by this method, but occasionally the staples have become loose and have had to be removed. They should be driven firmly home and should not be too large.

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[1] Cheyne and Burghard, *Manual of Surgical Treatment*, 1913, vol. iv.

The methods which aim at plugging the canal are not so much in favour as the foregoing. Watson Cheyne[1] has described a method of filling up the canal with a flap of pectineus muscle and fascia. Mansell Moullin[2] uses the pectineus and adductor longus. Schwartz[3] and Finney[4] use the adductor longus only. Thiriar[5] uses a decalcified bone-plate, which he sutures over the crural ring from within the abdomen. Wire-filigrees have also been used for the same purpose (Witzel and Goepel[6]).

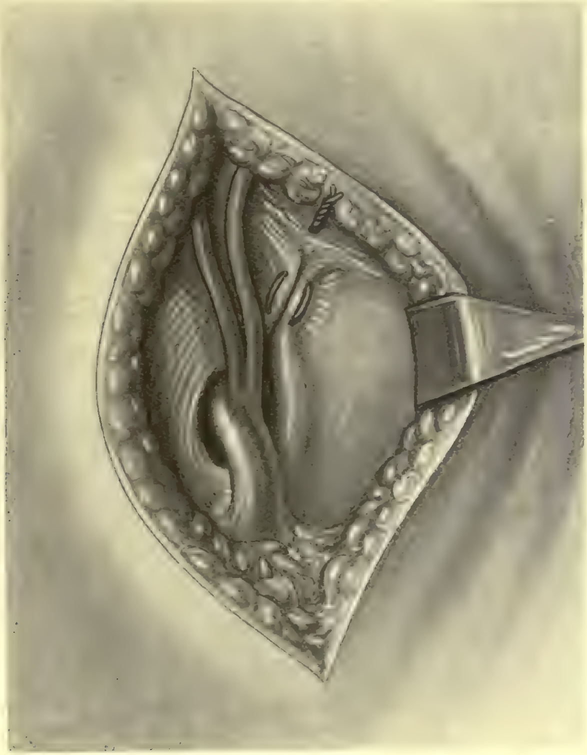

Fig. 46.—Cushing's operation for radical cure of femoral hernia; suture tied. (After Kelly and Noble.)

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[1] Watson Cheyne, *Lancet*, 1892, vol. ii. p. 1039.
[2] M. Moullin, *Lancet*, 1896, vol. i. p. 479.
[3] Schwartz, *Congrès de Chir., proc. verb.*, Paris, 1893, vol. vii. p. 689.
[4] Finney, *Midland Med. Journ.*, 1899, vol. xli. p. 151.
[5] Thiriar, *Congrès de Chir., proc. verb.*, Paris, 1893, vol. vii. p. 318.
[6] Witzel and Goepel, *Zentralbl. f. Chir.*, 1900, vol. xxvii.

Umbilical Hernia

Before deciding to perform an operation, and still more, before deciding on the nature of the operation, on a case of umbilical or ventral hernia, certain things must be carefully considered. The chief of these are the size of the hernia, the symptoms it is causing, and the type of patient in whom it occurs. The operation may be easy and successful, or it may be difficult, even dangerous, and not likely to succeed in its object. In general terms, the operation for a hernia of moderate size in a spare muscular patient is likely to be easy of performance and successful in result ; at the other extreme, a large complicated hernia in a fat woman with lax abdominal walls is likely to lead to an operation of difficulty, danger, and doubtful success. It may be stated at once that, of recent years, improved methods have made possible the radical cure of hernias of such a size, and in patients of so unfavourable a type, as formerly would have been considered impossible. Few, if any, hernias can now be regarded as incurable. In connection with recent improvements in operative technique must be mentioned the method popularized by W. J. Mayo,[1] and the implantation of silver-filigrees originated by Witzel and Goepel[2] in 1900 and advocated in England chiefly by M'Gavin.[3]

A suitable operation for a hernia of small or moderate size in a favourable subject is done as follows.

A large elliptical incision, with its long axis vertical, is made in the skin surrounding the hernia. The long axis of the ellipse should lie to one side of the middle line so that the resulting scar does not lie directly over the closed hernial opening in the deeper parts of the wound. The sac is freed and its neck carefully defined all round the opening in the abdominal wall. The sac is then opened at a point where there are no adhesions ; any adhesions that are present are separated by the finger or divided between ligatures. When the bowel has been returned it is best to ligature and remove the contained omentum and to return the stump into the abdomen. The sac must now be further dealt with. It is seldom possible to free the peritoneum all round the margins of the opening and to unite it satisfactorily, for there is usually so much tension that the stitches tear the peritoneum. It is best to bring the edges of the peritoneum together transversely, by introducing mattress-sutures through the muscle and peritoneum together ; these bring the edges of the opening into satisfactory apposition, as the sutures get a firm hold on the fibro-muscular tissue. The superficial edges of the ring, which then project forwards, are united by a continuous suture.

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[1] W. J. Mayo, *Journ. Amer. Med. Assoc.*, 1903, vol. xli. p. 225.

[2] Witzel and Goepel, *loc. cit.*

[3] M'Gavin, *Proc. Roy. Soc. of Med.* (*Surg. Sect.*), 1913, vol. vi. p. 103.

Still firmer closure of the opening may be obtained by utilizing the recti muscles for covering over the ring. The sheath of the rectus muscle is opened on each side and the muscles laid bare, their edges and posterior surfaces being loosened. To do this it is usually necessary to separate the transverse fibrous bands in the recti above and below the umbilicus and the incision must therefore be a free one. When the muscles have been sufficiently mobilized, their inner edges are brought into apposition over the closed hernial opening, which is thereby buried.

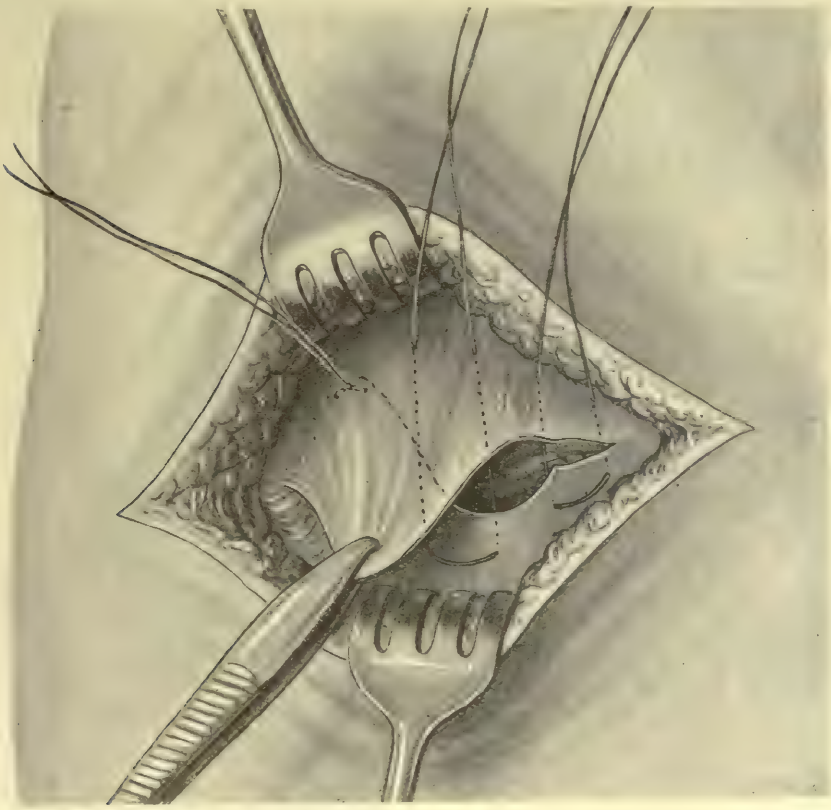

Fig. 47.—Mayo's method for radical cure of umbilical hernia. Note continuous suture in peritoneum and method of passing mattress-sutures to overlap and unite upper and lower aponeurotic flaps. (After Kelly and Noble.)

The above operation is not likely to succeed in large hernias in patients who have lax and fat abdominal walls. The operator, in this type of case, has the choice either of Mayo's method (which is suitable indeed for all hernias, both great and small) or of implanting a silver-filigree.

Mayo's method is thus described (Figs. 47 and 48) : [1]

1. A transverse elliptical incision is made surrounding the umbilicus and hernia ; this is deepened to the base of the hernial protrusion.

2. The surfaces of the aponeurotic structures are carefully cleared $2\frac{1}{2}$ to 3 inches in all directions from the neck of the sac.

3. The fibrous and peritoneal coverings of the hernia are divided in a circular manner at the neck, exposing its contents. If intestinal viscera are present, the adhesions are separated and restitution made. The contained omentum is ligated and removed with the entire sac of the hernia and without tedious dissection of the adherent portions of the omentum.

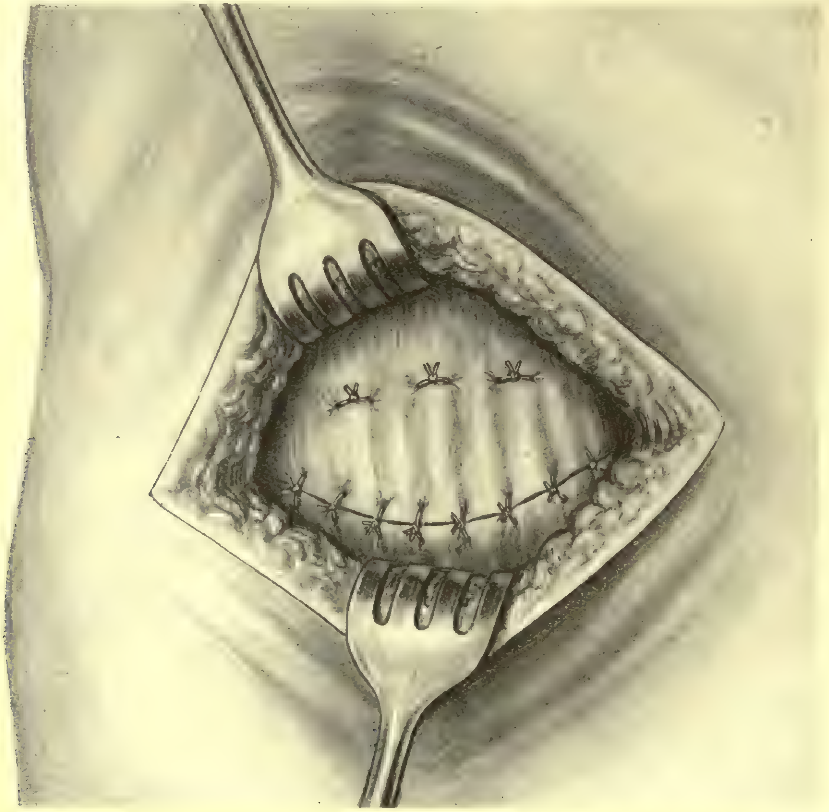

FIG. 48.—Mayo's method for radical cure of umbilical hernia ; mattress-sutures tied and free margin of upper aponeurotic flaps sutured to aponeurosis. (After Kelly and Noble.)

4. An incision is made through the aponeurotic and peritoneal structures of the ring extending one inch or less transversely to each side, and the peritoneum is separated from the under surface of the upper of the two flaps thus formed.

5. Beginning from 2 to $2\frac{1}{2}$ inches above the margin of the flap, three or four mattress-

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[1] W. J. Mayo, *loc. cit.*

sutures of silk or other permanent material are introduced, the loop firmly grasping the upper margin of the lower flap ; sufficient traction is made on these sutures to permit peritoneal approximation with a running suture of catgut. The mattress-sutures are then drawn into position, sliding the entire lower flap into the pocket previously formed between the aponeurosis and the peritoneum above.

6. The free margin of the upper flap is fixed by catgut sutures to the surface of the aponeurosis below, and the superficial incision closed in the usual manner. In the larger hernias the incision through the fibrous coverings of the sac may be made somewhat above the base, thereby increasing the amount of tissue to be used in the overlapping process.

For dealing with these large hernias, the use of a silver-filigree is, in experienced hands, a very successful method. In this country M'Gavin has been its chief exponent, and those who wish to use it should consult his publications.

After the sac has been dealt with in the usual way, the peritoneum is sewn up and the filigree is placed on the *outer surface of the subperitoneal tissues*, the muscles being raised sufficiently to enable its edge to be fixed firmly beneath them. The edges of the filigree are then firmly stitched to the surrounding tissues, the fibromuscular edges of the hernial opening are brought into as close apposition as possible, and the wound closed. When the hernial opening is large and the surrounding tissues much atrophied the filigree cannot always be placed as described above. It may then be placed in front of the muscular wall, the important point being that its edges should be firmly fixed all round.

Ventral Hernia and Scar-Hernia

Operations for the radical cure of ventral hernia, including scar-hernia, are very similar in principle and technique to the operations described for umbilica hernia. The site of the hernia and the anatomical structure of the particular part of the abdominal wall through which it passes are naturally important in planning the operation.

In scar-hernias great trouble may be caused by dense adhesions of omentum and bowel to the sac and also to the neighbouring peritoneum of the abdominal wall, especially in those cases where suppuration has occurred. In such cases the peritoneum should be opened at a little distance from the sac at a point where there are no adhesions. Caution must also be exercised in making the skin-incision, for interstitial prolongations of the sac are sometimes present between the muscular and fascial layers of the abdominal wall and even directly beneath the skin ; the bowel may be easily wounded in these situations. If there is great difficulty in separating the bowel from the peritoneum, a good plan is to divide the peritoneum all round the adherent patch and to return the bowel covered with the peritoneum into the abdomen.

After the sac and its contents have been satisfactorily dealt with, attention is directed to closing the hernial opening. The cicatricial edges are cut away and the individual muscles defined and mobilized as far as possible. The various muscular layers are then approximated by silk mattress-sutures. In hernias of the middle line the opening is best closed transversely and the tissues overlapped, as in the description for umbilical hernia.

In hernias through the *linea semilunaris*, difficulties are presented because of the different directions of the oblique and rectus muscles. Kelly[1] dovetails the rectus between the oblique muscles, and thus describes his method :

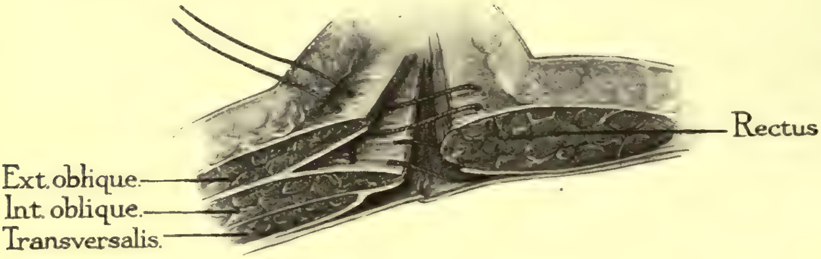

Fig. 49.—Method of dovetailing rectus between oblique muscles. (After Kelly.)

After dissecting out the scar tissue the margin of the rectus muscle is exposed, clean and clear, throughout the entire length of the wound. The lateral muscles are likewise laid bare. The next step is to split the lateral muscles, separating the external oblique with its stronger fascia from the internal oblique and the transversalis below. Fig. 49 shows the method of passing a single suture in profile.

The implantation of silver-filigrees is a most successful method of dealing with large scar-hernias, especially those which have followed the drainage of an abscess in lateral situations, such as an appendicular abscess, where the abdominal muscles are difficult to mobilize sufficiently to cover the opening. In such cases there is little hope of being able to cover the hernial opening with anything but skin and fascia, and the use of a filigree offers the only chance of radical cure. It is sometimes impossible to close the peritoneum completely, and large gaps have to be left. M'Gavin mentions a case in which he was compelled to suture the ileum to the caecum and these two to the margins of the gap, in order to make a bed on which to lay the filigree.

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[1] H. A. Kelly and E. Hurdon, *The Vermiform Appendix and its Diseases.*

Perineal Hernia

The hernia is approached by the perineal route. The sac nearly always contains small intestine; so far no cases have been reported where the sac contained any of the internal female genitalia.

It is not sufficient merely to excise the sac. The margins of the opening in the muscle must be united ; where the opening is too large or the muscle too defective, closure must be effected by utilizing a flap of gluteus maximus muscle, as in Exner's case.

DISEASES OF THE RECTUM

By J. P. Lockhart-Mummery, F.R.C.S.
(London)

Examination and Diagnosis

As a rule it is not necessary for the patient to be specially prepared for examination, as the rectum is usually empty. Where, however, the first examination proves to be unsatisfactory on account of the bowel not being empty, or in difficult and obscure cases, it is always advisable to arrange for the patient to have an enema administered previous to the examination.

The external part should be carefully examined first; then the anus should be gently separated with the fingers in order to see if there is a fissure present. If so, it will generally be found in the mid-line posteriorly, and more rarely anteriorly. The front of the finger suitably lubricated should be pressed towards the lateral wall of the anus and then slowly inserted. In this way the minimum of pain and discomfort will be produced. It should always be remembered that the vast majority of lesions in the bowel are within the last $\frac{3}{4}$ inch. For instance, the orifices of fistulae, fissures, polypi, piles, and the induration produced by abscesses in this neighbourhood, are generally to be felt within the first $\frac{3}{4}$ inch. The parts should be carefully palpated all the way round and any induration felt for. Finally, the finger should be passed as far up as possible, to ascertain whether there is any abnormality high up.

The Use of Specula.—The number of different forms of rectal specula that have been invented is legion; but very few of these are of any use in actual practice, and many of them are little more than instruments of torture. Most, if not all, of the expanding or bivalve types of specula are objectionable.

A very useful form of speculum is that illustrated in Fig. 50. It does not cause pain either in its introduction or withdrawal, while it gives a very excellent view of fissures and enables applications to be made to them.

Another form of speculum with which every surgeon should be provided, and which is particularly useful for the examination of piles and inflammation of the rectum, such as proctitis, etc., is the modification of Kelly's short rectal tube, which has for some years been used at St. Mark's Hospital (Fig. 51).

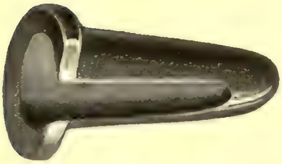

Fig. 50.—Rectal speculum.

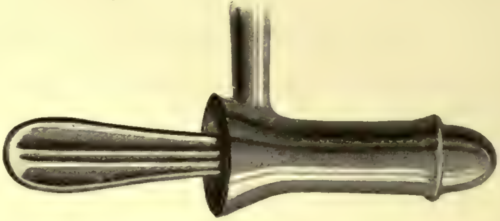

Fig. 51.—Kelly's short rectal tube (modified).

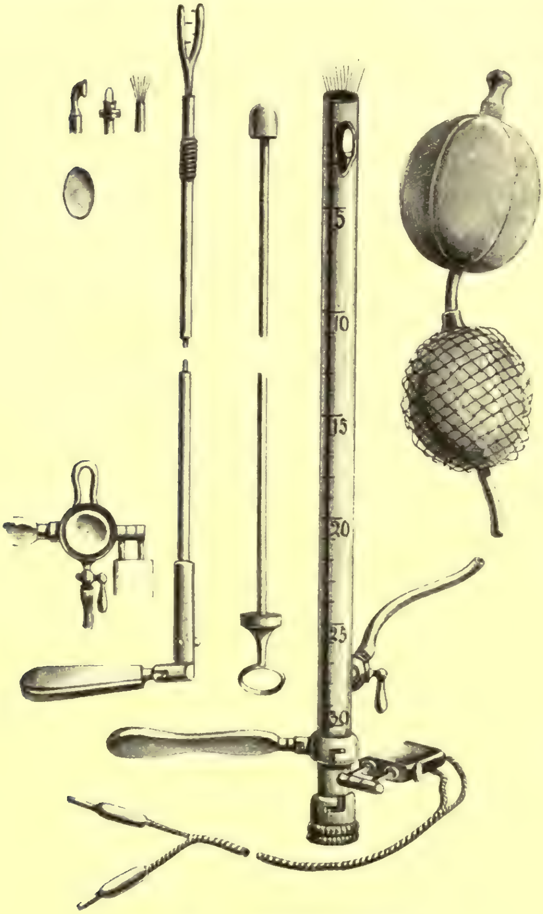

Fig. 52.—The sigmoidoscope.

The Use of the Sigmoidoscope.—To examine lesions in the upper part of the rectum or sigmoid flexure it is necessary to employ the electric sigmoidoscope (Fig. 52). This instrument consists of a tube closed at the back end by a glass window. In order to pass the instrument through the sphincters, the lamp attachment and back glass are removed and an obturator inserted. As soon as the nose of the instrument has passed in 2 or 3 inches the obturator should be removed, the lamp reintroduced, and the instrument subsequently passed by sight alone.

The tube is a straight one, and of course cannot go round curves; but what really happens is that the sigmoid flexure, which is a freely movable portion of the bowel, is threaded on to the instrument much in the same way as is the finger of a glove on to a stick. Care must be used in negotiating sharp curves, and on no account must the instrument be forced round the curve if there is definite resistance. If force is used under such circumstances it causes pain by putting the mesentery on the stretch, and may even cause tearing of the mesentery. With practice there is usually little difficulty in passing the instrument to its full length. It is, however, necessary to have considerable practice with the instrument before it can be of much value in diagnosis. The instrument is not so easily passed in women as it is in men. This is chiefly due to the fact that the angle of the sacrum is much greater in women and, consequently, the rectum has a considerable curve ; in the male it is an almost straight tube.

Examination under an Anaesthetic.—In cases where a satisfactory examination cannot be made in the ordinary way, or where there are obscure symptoms which cannot be accounted for, it is always advisable to make a thorough examination under full anaesthesia.

Examination of the Faeces.—In obscure cases of rectal disease a specimen of the faeces should be sent for examination to a clinical laboratory. A bacteriological examination may reveal the presence of tubercle bacilli, or the gonococcus. When the patient has been residing in hot climates, a microscopic examination of the faeces is particularly important. Among the more important parasites which may be discovered are the amoeba of dysentery, the parasite of sprue, and the *Bilharzia haematobia.*

Fissure in Ano

Fissure of the anus, or, as it is sometimes called, irritable ulcer, is one of the commonest of rectal troubles, and certainly one of the most painful. It is not in itself a serious affection, and to the uninitiated the lesion often appears so trifling as to be hardly worth considering ; and yet the pain which it may cause is so severe and prolonged that it often entirely incapacitates the sufferer.

Fissure of the anus almost always results from traumatism of some kind, such as stretching of the anus from the passage of hard faeces, or careless cleaning of the parts with hard paper after defaecation. Small polypi or hypertrophied papillae, if they are so situated that they can get caught in the grip of the external sphincter, may, by the irritation which they set up, give rise to a fissure. In some cases such a condition of affairs may be seen to exist ; a small polypus is found lying in contact with one portion of the anal margin, and on lifting this up a fissure is seen beneath it.

Symptoms.—The chief symptom in the majority of cases is pain coming on after an action of the bowels. The pain is often extremely severe, and, indeed, it is quite astonishing how much pain may result from a minute fissure. The pain may come on immediately after the bowels have acted, or it may not come on for half an hour, or even longer in some cases. It often lasts for several hours and sometimes for the rest of the day. Many patients are almost unable to sleep at night on account of the shooting pain caused by involuntary spasm of the sphincters which occurs just as they are falling off to sleep. Patients with fissure often say that they have noticed that the faeces are streaked with blood. The quantity of blood, however, seldom amounts to more than a drop or two.

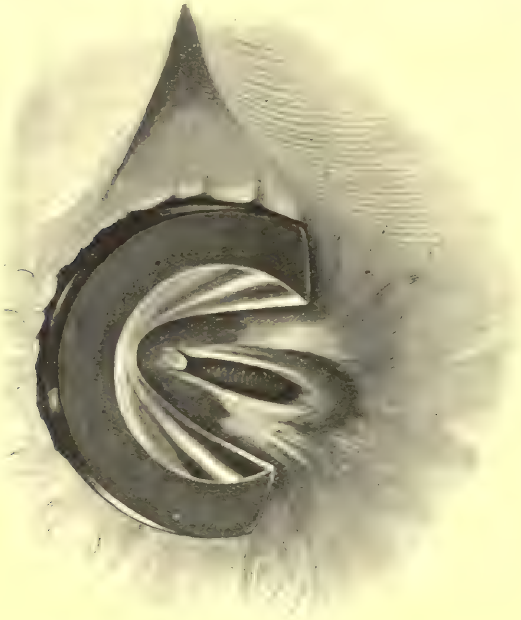
Fig. 53.—Fissure as seen through an anal speculum.

Reflex Symptoms.—In women pain referred to the uterus or vagina is a common accompaniment of anal fissure. Dysmenorrhoea and other uterine symptoms may easily lead to a wrong diagnosis, and much time may be wasted in futile treatment for supposed uterine trouble when the real cause of all the symptoms is to be found in an anal fissure.

On account of the pain which results from defaecation many patients with fissure put off relieving the bowels as long as possible, and the resulting constipation often greatly aggravates their condition, besides resulting in much increase of the pain when defaecation ultimately takes place.

Treatment.—Fissure in ano is a condition which can almost invariably be cured both readily and effectually, and there are no more grateful patients than those who have been cured of this painful affection. A great many cases of fissure can be cured without operation, but it is important to know which cases can be expected to yield to non-operative treatment. As a rule it may be said that fissures situated anteriorly or laterally can be cured without operation. Fissures of recent origin can generally be cured by palliative means—that is to say, fissures which have only existed for a short time, which have not indurated edges, and in which the fibres of the underlying sphincter muscle are not exposed. Such fissures will usually heal without surgical operation. On the other hand, fissures which have existed for a considerable time, and the edges of which are thick and indurated, or which have a small polypoid growth at their upper extremity, or in the base of which the fibres of the sphincter muscle can be seen, most usually require an operation for their cure.

Non-Operative Treatment.—A certain number of fissures will heal by means of simple remedies. Care should be taken to regulate the patient's bowels so that the stools are soft and unirritating. Some suitable sedative application should be employed to relieve the pain and spasm after defaecation. One of the following ointments should be introduced, either with an ointment introducer or with the finger, in the morning and after each action of the bowels.

I

℞

Subnitrate of bismuth . . .	2 drachms
Cocaine	10 grains
Sub-chloride of mercury . . .	15 ,,
White vaseline	1 ounce.

II

℞

Anaesthesin (Ritsert) . . .	70 grains
Lanoline	3 ounces

III

℞

Sub-chloride of mercury . . .	4 grains
Powdered opium	2 ,,
Extract of belladonna . . .	2 ,,
Vaseline	1 drachm.

Operative Treatment.—The sphincter is carefully stretched and the bowel washed out with soap and water, and subsequently with an antiseptic, a little iodine or pure carbolic acid being applied to the fissure itself. If small, the fissure is then completely excised, care being taken not to cut deeply into the external sphincter nor to remove more tissue than is absolutely necessary. Or the more usual method is to make an incision starting at the upper end of the fissure downwards and dividing it well out on to the skin. If a sentinel pile is present, this should be simply cut off. The edges of the wound thus made are then trimmed off with scissors, together with any thickened edge of the fissure and the oedematous tag which often exists at the lower end. One's aim should be not to leave a slit-like wound, but rather a flat, open, oval wound, two-thirds of which should be on the skin outside the anus and only one-third within the bowel.

After-Treatment.—The wound should be dressed twice daily after the first twenty-four hours. The patient should sit in a hip-bath and soak the parts, and then the wound should be dressed with a small piece of cotton wool soaked in sterilized olive oil. The patient must be kept in bed or on a sofa until the wound has quite healed. The bowels should be kept acting daily by some mild aperient.

Fistula

By a fistula we generally understand a granulating track opening from a mucous canal on to the skin-surface. As the term is applied in rectal surgery, a fistula means an abscess opening either into the rectum or anal canal, or on to the surface of the skin in the immediate neighbourhood of the anus. The common causes of fistula are — fissure or ulcer, ischio-rectal abscess, tubercle, stricture, foreign bodies, and necrosis of the pelvic bones. It used to be taught that most fistulae were tuberculous in origin, but this is very far from being the case. It is probable that not more than about 10 per cent of all fistulae are tuberculous in origin. One of the reasons why nearly all fistulae were considered tuberculous was that they were found to heal with great difficulty, and the surgeon in attempting to account for his failure concluded that it was because the lesion was of a tuberculous nature. When fistulae are tuberculous they may be primary, but more frequently they are secondary to a lesion in the lung.

Symptoms.—The first stage of almost all fistulae is an abscess near the anus. The abscess may only cause inconvenience for a few days, and then apparently heal up. If it were the practice to open all abscesses in this situation directly pus began to form, I believe many patients would be saved from the trouble of a fistula. Unfortunately when an abscess forms near the anus, it is a common practice for the doctor to advise the use of poultices or fomentations with the object of reducing the pain and inflammation.

The external opening of a fistula is generally quite small, and very often there is a little protruding piece of skin guarding the opening, or a button-shaped granulation. At other times the external opening only appears as a pink depression on the skin, or can only be discovered by the oozing of pus from the opening when pressure is exerted upon the tissues in the neighbourhood.

The amount of pain which a fistula causes varies considerably. As a rule there is very little pain, and all that is complained of is an occasional dull ache or sense of discomfort. It is usually only when a fresh track or abscess is forming that the patient suffers any inconvenience, for at other times pain is generally absent. There is usually a certain amount of discharge, though this is never large in quantity except in very extensive fistulae.

Tuberculous fistulae cause very few symptoms unless accompanied by ulceration of the anal margin or rectum.

Treatment.—It is still often taught that the non-healing of a fistula is due to the movements of the sphincter muscle, and that, on this account, it is essential that the muscle should be divided in order to obtain healing of the fistulous track. But from my personal experience I am sure that the movements of the sphincter are a very small and unimportant factor in preventing healing. The really important hindrance to the spontaneous healing of a fistula is inadequate drainage. If the track of the fistula is thoroughly drained by carefully-planned incision of the parts, healing will take place, even if none of the muscular structures have been divided. When possible, the wound should be so planned that the portion of it involving the skin is considerably wider and larger than the portion involving the mucous membrane and the bowel; this will often require what, at first sight, appears to be an unnecessarily large wound. The maxim to ensure success in operating for fistula is, " Provide free drainage to all parts of the track." Not only must adequate drainage of the fistulous track be provided at the primary operation, but adequate drainage during the whole period of healing. It often happens that healing is rapid at first, but when the fistula appears to be almost healed, the process seems to stop and further healing fails to occur; the explanation is that the drainage has become inadequate.

Where a fistula is very large and its tracks are deep, it is not always possible to " provide free drainage to all parts of the track " without danger of producing incontinence, and it is here that experience is of the utmost value. In such cases it is usually better to compromise, for it is both easier and better to perform a second operation for the purpose of re-establishing good drainage, when the wound has refused to heal further, than to have to perform a second operation for incontinence. If the surgeon is not satisfied that he has provided adequate drainage, he should tell the patient that a further slight operation will be necessary; for if the patient is not so warned, she will suppose that something has gone wrong for a second operation to be required.

It is a great mistake to operate upon a fistula when there is acute inflammation. When much pus is being discharged or a large abscess is present, the operation should not be performed. The proper treatment in such a case is to ensure that there is free drainage, by enlarging the existing openings for the purpose, if this is found to be necessary, and to have the tracks and pockets frequently irrigated with peroxide of hydrogen or some suitable antiseptic solution.

Operation in the Case of a Simple Fistula.—The simplest kind of fistula to operate upon is that in which there is one straight track between the external and internal openings. Before proceeding to deal with the fistula, it is most important, in all cases, to make a very thorough examination with a view to ascertaining that there are no other tracks or complicating conditions. It is often possible to find out much more about a fistula when it is examined under an anaesthetic than it was possible to discover when the fistula was examined in the consulting-room. Not infrequently it

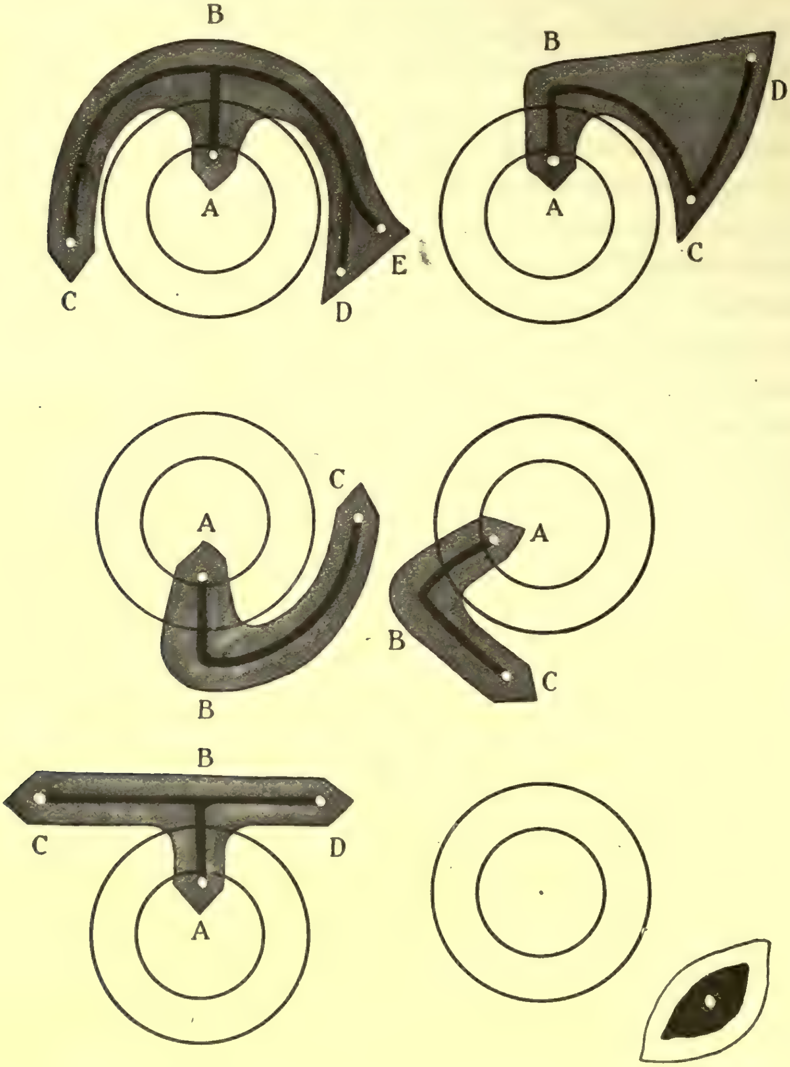

Fig. 54.—Diagrams to show the method of incising different forms of fistulae.

A, internal opening; B, nearest point of fistula radially from A. The incision from B to A is made after the remainder of the fistula has been divided. In each diagram the fistula is shown as a black line, the openings as white dots; the shaded areas show the shape of the wound left after operation. (The upper end of each diagram is posterior.)

will be found that a fistula which was thought to be a simple one is a complicated one, there being deep tracks hitherto undetected. Supposing, however, it has been found that the fistula is a simple one, a curved steel director with a fairly thick point should be passed up the track of the fistula through the external opening and made to emerge through the internal opening of the fistula and out at the anus. The director being in place, all the tissues overlying it should be divided with a knife, either by passing a curved bistoury along the groove of the director and slitting up the tissues by transfixion, or by cutting down on the director with an ordinary scalpel. The director is then free and may be removed. All granulation tissue lining the fistulous track is then scraped away with a Volkmann spoon, and the fibrous track left is carefully examined in a good light to make sure that there are no others, the openings of such tracks, where they exist, being generally seen as dark holes lined with granulation tissue. Lastly the edges of the wound must be freely cut away so as to leave an open wound without overhanging edges. Healing occurs much more rapidly in a wound which is open than in a narrow slit with thick, overhanging edges, and, moreover, the resulting scar is smaller and less unsightly.

Complicated Fistula.—When the fistulous track is not straight, or when there are other tracks communicating with the same internal opening, the external tracks should first be laid open, and last of all the track passing to the internal opening should be divided in the way already described, care being taken to make the incision into the bowel in an antero-posterior direction, or, in the case of a fistula with a lateral opening, radially to the anus.

Causes of Non-healing of the Wound after an Operation for Fistula.—(1) Inadequate operation. (2) Insufficient drainage. (3) Too tight plugging of the wound. (4) Bridging of the wound. (5) Some constitutional condition of the patient.

HAEMORRHOIDS

Haemorrhoids are generally divided into two main varieties—internal and external—though in many particulars the two differ so widely, both in symptoms and pathology, that they should be regarded as entirely separate conditions.

Chronic constipation is a common cause of haemorrhoids, because it results in pressure upon the pelvic veins, and so directly conduces to stagnation and engorgement in the haemorrhoidal veins. For the same reason cirrhosis and congestive conditions of the liver, pelvic tumours, and pregnancy are common causes of piles. During pregnancy there is always a certain amount of congestion of the pelvic veins, and in a woman with any tendency to piles this will often result in their becoming very troublesome at this period. When piles complicate a pregnancy, they are usually most troublesome either during the first three months of the pregnancy, that is until the uterus has begun to rise out of the pelvis, or during and immediately after labour. Sometimes they give rise to a good deal of trouble during the last months of pregnancy, but in my experience bleeding and prolapse are generally most troublesome during the puerperium.

Symptoms.—In uncomplicated cases, the symptoms of internal piles are chiefly bleeding and prolapse. The amount of bleeding which occurs varies very considerably in different cases. Sometimes the patient says there has never been any bleeding. This may be due to the fact that the patient is accustomed to evacuate the bowels in some dark closet, and consequently has failed to notice the bleeding. But patients may present themselves for treatment on account of prolapse who have never suffered from haemorrhage. Haemorrhage probably occurs in nearly 85 per cent of all cases of piles, although in about half that number it is not very profuse.

After a time, internal piles become markedly pedunculated and prolapse through the sphincters. At first this prolapse only occurs as the result of straining at stool, and readily goes back, but in time it refuses to return unless pushed back ; and in cases of old standing the piles prolapse quite independently of an action of the bowels, often coming down while the patient is walking about, and thereby causing great discomfort. Under such circumstances the piles are a constant source of annoyance to the patient, and at any time may become strangulated and cause extreme pain. In bad cases of prolapsing piles a certain amount of incontinence to flatus and the fluid-contents of the bowel results, and this, by keeping the skin of the anus moist, often leads to pruritus and excoriation of the skin.

Although internal piles are, as a rule, not painful they are inclined to give rise to reflex symptoms. Thus they may cause bearing-down pain, which in women is usually mistaken for a prolapse of the uterus. Before attempting to treat a case for uterine prolapse it is always wise to make sure that the cause of the discomfort is not in the rectum. It must also be remembered that in a bad case of uterine prolapse there is often an accompanying prolapse of the rectal mucous membrane, and it is useless to treat a case of rectal prolapse where there is marked uterine prolapse unless the latter condition is treated at the same time.

Treatment.—The treatment of internal piles is usually divided into palliative and operative. The word ' palliative ' is here used in its true sense, for, with but few exceptions, no treatment other than operation will cure internal haemorrhoids. Non-operative treatment will often relieve the symptoms, and if persisted in, will sometimes keep the patient free from discomfort for a considerable time ; but a cure of the condition by anything short of operation is only possible in a few exceptional cases. It is necessary to distinguish clearly between a cure of the piles and a cure of the symptoms. The latter is often possible by suitable and carefully carried out palliative treatment, but a real cure by this means is seldom possible. Apart from the fact that a cure of the piles cannot be effected by non-operative treatment, there is but little advantage in its use. It is tiresome, and has, of necessity, to be continued for a long time ; and, as a rule, the patient has ultimately to submit to an operation. When a patient has well-marked internal haemorrhoids nothing is to be gained by waiting. The operation for piles is one of the safest in surgery, and enables the patient to be cured in the space of ten days or a fortnight.

The Treatment of Piles in Pregnancy.—The treatment of internal piles in pregnant women requires special consideration. If the piles are causing serious trouble during the early stage of pregnancy, that is to say, up to the fourth month, one must decide whether it is not advisable to operate. The probability is that if the piles are causing much pain or bleeding in the early stages of a pregnancy, although some improvement in the condition will occur during the middle stages, the piles will almost certainly give rise to much trouble just before, during, and after labour. Piles are not, as a rule, a serious complication ; yet the pain which they often cause, associated as it frequently is with severe bleeding, is a complication to be avoided if possible. The risks of an operation during the first four months of pregnancy are very slight. If the operation is carried out under proper conditions the danger of a miscarriage is almost negligible, and the patient will make a good recovery. I have frequently operated on internal piles in pregnant women up till the sixth month and have never seen any harm result. If, therefore, the piles are bad and are causing much trouble, operation is probably the best course. In the late stages of pregnancy it is not advisable to operate unless the piles are very bad and refuse to yield to palliative treatment. Rest in bed after the bowels have acted, cold-water douches, and astringent ointments, together with a careful use of aperients, constitute the best treatment in these cases.

It is a mistake to suppose that the condition of profound anaemia sometimes produced by constant bleeding from haemorrhoids is a contra-indication to operation. On the contrary, an immediate operation affords the only means of preventing the risk of a fatal issue and of removing the cause of the anaemia.

Palliative Treatment.—This is directed to removing any congestion of the portal circulation and diminishing the size of the piles by the application of astringent medicaments. The bowels should be kept acting regularly, and for this purpose nothing is better than salts in some form. Apenta, Villacabras, and Friedrichshall waters are very useful ; or some simple mixture of magnesium sulphate may be prescribed.

Local applications to the rectum may take the form of suppositories, ointments, or injections.

The patient should be told to inject cold water into the rectum night and morning with a 6-ounce rectal syringe. Tincture of hamamelis may with advantage be added to the water in the strength of 1 drachm to the pint.

If ointment is used, it should be introduced well into the rectum with an ointment introducer; or better, the ointment should be ordered in a collapsible lead tube to which can be screwed a short bone nozzle with lateral openings. This is introduced into the rectum, and some of the ointment is squeezed out as the nozzle is being withdrawn. These tubes with a bone nozzle are now always used at St. Mark's Hospital in preference to the old ointment introducer.

The following ointments and suppositories are recommended:

℞

Extract. suprarenalis . . .	ʒii
Olei theobromi	ʒvii

Fiant suppositoria xii.

℞

Ichthyol Tannic acid	aa grs. v
Extract. belladonnae Extract. stramonii . . .	aa gr. ⅓
Extract. hamamelis . . .	grs. x
Olei theobromi	q.s.

Fiat suppositorium.

℞

Ung. acidi tannici . . .	ʒiv
Ung. stramonii Ung. belladonnae . . .	aa ʒi.

Operative Treatment

The Ligature Operation.—The method of preparation which is employed at St. Mark's Hospital, and which has been in use for many years, is as follows: Two rhubarb and colocynth pills are administered on the night of admission, and this dose is repeated on the following night. The night before operation the patient is given a dose of opium and catechu, and the following morning, some four hours before operation, the lower bowel is washed out with enemata. The chief feature in this method of preparation is the use of opium and catechu on the night before operation, followed by an enema the next morning. The effect of the opium is to inhibit peristalsis, so that, when the enema is given, the lower bowel is emptied without inducing peristalsis and bringing fresh material from above into the field of operation.

The patient, having been prepared for operation in this manner, is then anaesthetized until full relaxation is obtained. It is important that there should be full relaxation, as otherwise the piles cannot be reached properly without thoroughly stretching the sphincter, and it is desirable to avoid this if possible. Ether is much safer than chloroform for rectal operations, and should be used in all but exceptional cases.

The patient should be placed in the lithotomy position, with the buttocks well over the end of the table. The anus should be separated, and, if necessary, slightly dilated ; but it is unnecessary and undesirable to stretch the muscle, provided that the latter is not hypertrophied and that the anaesthetic is properly given. In almost all descriptions of this operation dilatation of the sphincters is insisted upon as a necessary preliminary; but for some years I have quite given up the practice, and now never stretch them unless it is absolutely necessary to get at the piles, or unless there is obvious hypertrophy of the sphincter which requires correction.

Each pile is seized at its extremity with artery forceps, and all the forceps are left hanging out of the anus, attached to their respective piles. There are usually three main piles, and sometimes two extra small ones. When the whole of one side of the rectum seems to consist of one large pile, or when one of the piles is very large, it should be treated as if it were two piles—that is to say, two pairs of forceps should be applied to it, and it should be split up between them. The surgeon having satisfied himself that all the piles have been caught in forceps, takes the clip attached to the lowermost pile in his left hand, and places the first finger of the same hand on the inner or upper surface of the pile (Fig. 55). Then, with a pair of straight, blunt-pointed scissors, he cuts into the junction of the pile with the skin just at its base (Fig. 56). This cut should open

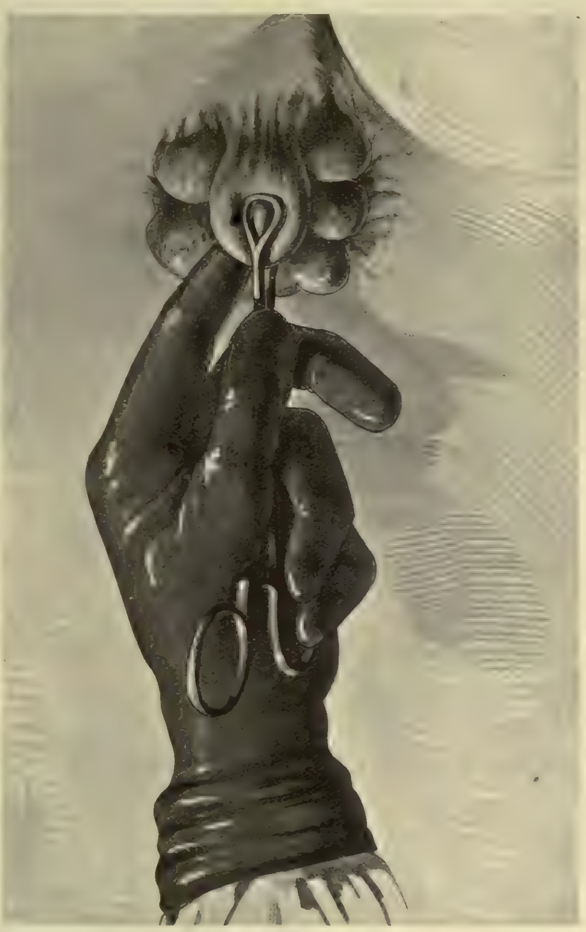

Fig. 55.—Method of holding pile while making incision.

up the submucous space, and the pile should then be stripped up till it remains attached only by its upper end which contains the vessels feeding it. My own

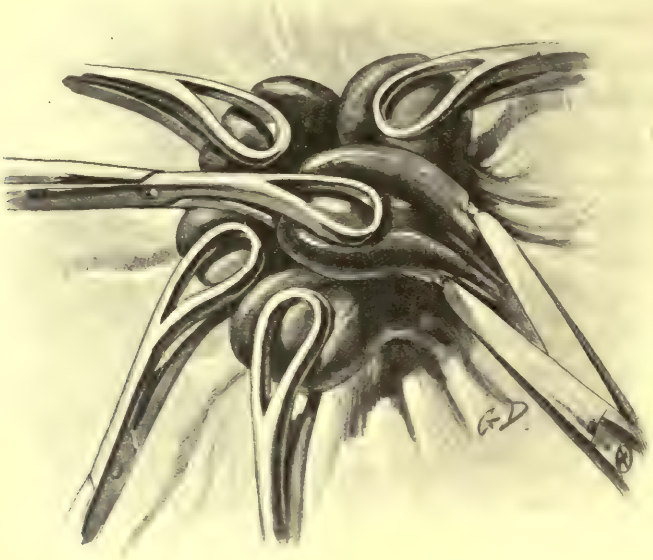

Fig. 56.—First stage in operation for piles by ligature.

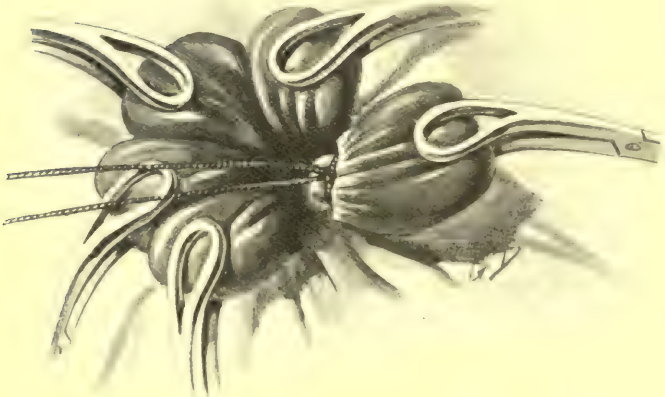

Fig. 57.—Ligature of pile completed.

practice is to crush the pedicle of the pile in a powerful pair of crushing forceps before applying the ligature. This completely obliterates the vessels in the pile and ensures that the ligature is tight. The clip is now handed to the assistant, and the surgeon takes a ligature which should be about 8 inches long. The material for the ligature is important, and the best is hollow-plaited silk, No. 8. The centre of the ligature is placed in the groove formed by the separation of the pile from the rectal wall, and the assistant then drags the pile outwards across the ligature, which is tied as tightly as possible round the neck of the pile and with the knot on the bowel aspect (Fig. 57). If there are any spurting vessels where the pile has been separated, these should be clipped in artery forceps.

When all the piles have been ligatured, the ends of any that are large should be cut off, but care must be taken not to endanger the ligature slipping. Part of each ligature is then cut off, so as just to leave the ends hanging out of the anus. The surgeon should next insert his finger into the rectum, and if there is any narrowing caused by the tying of the piles, he should stretch this until it no longer exists.

Any bleeding points that have been picked up with forceps will next require attention. If small, they should be twisted, but otherwise tied off with fine silk, the ends of which should be left long as before. The parts having been cleaned up, about a drachm of sterilized vaseline is squeezed into the rectum from a collapsible tube, and a short piece of drainage tube is inserted into the anus. The dressings are then applied and held in place by a T bandage. The operation in experienced hands should not take more than five or six minutes to perform.

After-Treatment.—The dressings should be changed twice a day, and the external parts washed with weak carbolic lotion. I always remove the tube in twenty-four hours. Its chief object is to prevent oozing, and to give warning if there is concealed haemorrhage ; it is therefore unnecessary to retain it longer, and it often causes discomfort after twenty-four hours.

The bowels are confined for two or three days. If the patient complains of distension an aperient is given on the second day, otherwise on the third. To relieve the bowels my own practice is to administer an ounce of castor oil and at the same time to give an injection of 3 or 4 ounces of olive oil into the bowel with a No. 10 soft rubber catheter. This should result in an easy action without pain or serious discomfort. After this the bowels are kept acting daily with some mild aperient such as cascara or salts. The patient is confined to bed until the ligatures come away, which usually occurs about the eighth to the eleventh day.

Whitehead's Operation.—I have always been an uncompromising opponent of this operation as the right treatment for ordinary cases of internal piles, and I have never been able to see any reason for preferring this operation to the other and simpler methods. Whitehead's original contention, that recurrence was impossible after this operation, has long ago been disproved. Recurrence is certainly as common as, if not commoner than, after a properly-performed ligature operation ; while other complications are much commoner, and far more serious, than after the ligature or clamp and cautery methods. Personally, I have never used it for an uncomplicated case of piles, but have done so on a good many occasions when the piles were complicated by a considerable prolapse of mucous membrane.

With modifications, it is also a useful operation in some cases of stricture very near the anal orifice. If it is recognized that the operation should be reserved for a few special cases, I think it has a useful place in rectal surgery.

After-Results and Complications of Pile Operations.—All operations for piles used to be accompanied by considerable pain, and it was the custom to give morphia, or some other form of opium, for days after the operation. It is, however, now possible to prevent this pain if the operation is properly performed, and if the after-treatment is properly carried out; and the operation for piles should result in no more pain than one for hernia or varicose veins. The pain after an operation for piles—as, indeed, after most operations—is due to swelling of the tissues and to the wound becoming inflamed. A primarily aseptic wound does not cause pain, with the exception of some of the bone operations and operations upon joints. After removing the piles the wound must be kept clean and the tissues aseptic for some hours, and then there is no severe pain. If great care is taken in operating upon piles to make the wounds through clean tissues, and to keep the wound clean for some hours afterwards, pain is not present in any marked degree in the majority of cases.

PROLAPSE

The factors tending to produce rectal prolapse in women naturally fall into several groups. Conditions associated with severe straining and tenesmus may produce prolapse, just as they may produce hernia. Thus, chronic cough, proctitis, and the bad habit of sitting at stool for long periods, all tend to produce prolapse. Tumours of the bowel, like polypi, are often causes of prolapse. Traumatism, too, may cause prolapse. Thus, we find it sometimes after operations which have left a patulous condition of the sphincter ani, and after severe laceration of the perineum in childbirth. It may also result from mere loss of muscular tone in the parts, or from paralysis of the sacral nerve-trunks. Once a prolapse has been established, it tends to increase in size each time it comes down, and to drag more and more bowel into its walls. The sphincter, from constant stretching, soon loses its tone and becomes patulous. As the support of the sphincter is lost in this way, the prolapse tends to come down more and more easily, so that after a time it comes down on the slightest effort, such as sneezing or blowing the nose.

A new theory of the etiology of rectal prolapse has recently been propounded by A. V. Moschowitz of New York. He asserts that prolapse starts as a hernia of the small intestine from the bottom of Douglas's pouch, through the anterior rectal wall above the anal canal. He also states that a sulcus of the depth of about an inch can always be found between the sphincter and the anterior wall of the prolapse. I cannot agree with him that this sulcus is present except in a very small percentage of cases. Nor can I believe that this theory will explain more than a small percentage of cases of rectal prolapse. My experience does not confirm Moschowitz's contention that the earliest stage of prolapse is a hernia of the anterior rectal wall above the level of the anal canal. Those who are interested in the subject should consult Moschowitz's interesting paper.

A prolapse which protrudes for more than about 2½ inches may contain a portion of the peritoneal cavity between its coats. The peritoneum is first dragged down in the front portion of the prolapse, and as the prolapse becomes larger, more of the peritoneal cavity becomes involved, so that in a large prolapse the inner layer may be completely surrounded by peritoneum. Owing to the fact that the peritoneum extends much lower on the anterior wall of the rectum in the female than in the male, the peritoneal cavity is involved with a lesser degree of prolapse in women than in men.

Complications.—There are several complications which may occur in severe cases of prolapse. Thus, a loop of intestine may come down into the peritoneal cul-de-sac, which has been dragged down by the prolapse, and become strangulated there in the same way as it would in a strangulated hernia. Rupture of the walls of the prolapse with the protrusion of intestine is a rare and dangerous condition, which has been known to result from forcibly attempting to reduce an inflamed and oedematous prolapse. Severe ulceration of the protruding portion, with possible perforations of the peritoneal cavity, is another rare complication.

Symptoms.—At first the prolapse only comes down while at stool, and is easily replaced, or, more often, returns of itself in the course of a few minutes or after the patient has lain down. After a time, however, the prolapse will not go back unless replaced, and this may sometimes be quite a difficult thing. As the sphincters give way, the prolapse comes down so readily that the patient is unable to hold her breath without forcing down the prolapse. It will come down on the least attempt to blow the nose, sneeze, or cough, and some patients are unable to walk about without its coming down immediately. A certain amount of bleeding often occurs, but is never serious. Pain of a bearing-down character usually accompanies the condition ; difficulty with micturition and other symptoms, due to dragging upon the pelvic organs, are generally present in severe cases. The condition is one which causes the most profound misery to the unfortunate patient, and although not dangerous is exceedingly incapacitating.

Treatment.—The difficulty of curing a case of prolapse of the rectum, when the prolapse is of any size, has become proverbial. I know of no method of treating prolapse in adults, short of operation, that has the slightest prospect of success, nor have I ever seen a case really cured apart from operation. Unless the patient is willing to submit to an operation, the best that can be expected is that the condition may be to some extent alleviated by the wearing of an apparatus for preventing the descent of the prolapse. This will, however, result in considerable discomfort, and probably in incontinence.

The *operations* for prolapse of the rectum in adults may be roughly divided into two classes—those which aim at suspending the bowel from above, including all the different forms of colopexy, and those which aim at fixing the rectum itself into the hollow of the sacrum and to the pelvic fascia, that is to say, at restoring the bowel to its original condition by the aid of adhesions or stitches. These operations are usually called " proctopexy."

With the exception of cases of prolapse of the third degree, which are really cases of intussusception of the upper end of the rectum and not of prolapse, the latter type of operation is the most satisfactory, and is likely to be followed by the best results. It has the additional advantage that it does not necessitate opening the peritoneal cavity, and there is therefore less risk attached to the operation.

If the prolapse is complicated by a ruptured perineum from child-birth, and especially if it is accompanied by severe prolapse of the uterus, it is useless to hope to cure the rectal prolapse without at the same time restoring the perineum. Either the perineum should be first restored by a proper plastic operation, or the two operations should be performed at one time. In some cases of rectal prolapse, where the prolapse is not a large one and there is a bad tear of the perineum, an operation for the latter condition will result in a cure of the prolapse. This is, however, not likely to be the case if the prolapse is a large one and contains a portion of the peritoneal cavity.

Lockhart-Mummery's Operation.—The patient is carefully prepared for operation in the manner already described. This is of great importance, for it is essential to ensure that no action of the bowels shall take place for at least four or five days after operation ; in fact, until steps are taken to that end.

The length and degree of the prolapse must first be ascertained by seeing the bowel in the prolapsed condition. If at the time of operation the prolapse is down, it should be carefully returned. The patient should be placed in the lithotomy position, with a small sandbag under the sacrum. The lower part of the rectum is then thoroughly washed out with spirit-soap and water by the aid of flat swabs. It is then douched out with lysol, 1 drachm to the pint, and any excess of the solution removed by dry swabs. The external skin around the anus and over the coccyx should previously have been painted with 2 per cent iodine solution.

A transverse incision about 2 inches long is then made at a point about half-way between the tip of the coccyx and the posterior margin of the anus. This incision is deepened, keeping slightly backwards towards the coccyx, and in it the attachment of the external sphincter to the coccyx should be completely divided. The incision is carried down, a knife or blunt-pointed scissors being used, towards the tip of the coccyx until the posterior rectal space is opened up. Great care must be taken on no account to open the rectum in making this incision. A gloved finger is then inserted into the posterior rectal space through the incision, and this space is thoroughly opened up to each side of the rectum and up along the hollow of the sacrum. As a rule the space strips very easily, as the cellular tissue is very loose as the result of the prolapse. The amount to which the posterior rectal space should be separated must depend upon the extent of the prolapse. Roughly, the extent upwards to which separation should be carried out is about equal to the length of the prolapse when down. The separation should be done entirely by blunt dissection with the finger, or with blunt-pointed scissors, so as not to cause haemorrhage, and the greatest care must be taken to preserve complete asepsis during this stage of the operation. If necessary, the surgeon may keep the first finger of the gloved left hand in the bowel to guide him in the separation. The separation should be carried round the sides of the rectum as well as up along the posterior wall, so that the subsequent adhesions shall hold as much as possible of the rectum, and not merely one small part of it. This done, a long strip of sterilized bismuth gauze—it must be ribbon gauze with a selvedge—should be carefully packed into all the separated area of the posterior rectal space, the object being to leave sufficient gauze to prevent primary union between the rectal wall and the sacrum, but to avoid using so much gauze as would cause pressure upon the rectum or be likely to produce sloughing. When the prolapse is large and of old standing the separation should be carried into the space above the levator ani and between this muscle and the rectal wall on each side. Two or three strips of gauze should be used, and the ends left hanging out of the posterior wound.

A portion of the anterior wall of the mucous membrane of the rectum just within the anus should be seized in forceps, and a ligature tied round it so as to prevent any tendency to prolapse of this small portion of mucous membrane, which is otherwise liable to prolapse into the patulous anus after the posterior wall has been fixed. As a rule it is not necessary to perform any operation on the anus, as recovery of the action of the muscle will usually take place in course of time. If it is very patulous, however, some form of plastic operation may be performed at the same time.

The gauze should be left in place until about the sixth or seventh day, and then parts of it should be slowly removed each day, fresh gauze being lightly packed into the space left. The object of the packing is to make the whole of the space up behind the rectum heal by granulation so as to produce the maximum number of adhesions in this area. After this the dressing should be done daily, and the total time for the posterior wound to close should not be less than three weeks. The bowels are opened by means of oil enemata about the sixth day, and great care must be taken to prevent infection of the posterior wound before this. After that time granulation will have already occurred, and no serious results will follow infection of the wound.

The patient should be kept lying flat for at least a month after the operation, and in cases of a bad prolapse it is wise to insist on the bowels being opened while the patient is in the recumbent position for another month after this. After the sixth day the bowels should be kept acting by means of daily oil enemata, and care should be taken to prevent straining.

NON-MALIGNANT STRICTURE OF THE RECTUM

Non-malignant stricture may be congenital, spasmodic, inflammatory, or fibrous. Congenital strictures most commonly occur at the point of union of the proctodeum and the hind gut, which is represented in the adult rectum by the lower edges of the valves of Morgagni.

Spasmodic stricture is occasionally met with, although it must be considered a very rare condition. It is due to a spasmodic contraction of the circular muscle-fibres of the rectum.

The commonest form of non-malignant stricture met with in the rectum is a fibrous stricture. This is due to inflammation which has caused destruction of tissue and resulted in the deposit of fibrous tissue in its place, which has subsequently contracted. A very considerable degree of inflammation is necessary to produce fibrous stricture in the rectum.

Quite a number of cases of severe stricture of the rectum are seen in women as the result of severe and prolonged labour. The stricture in such cases is always in the same place, namely about 2 to 2½ inches above the anus. I believe the cause of the stricture in these cases is sloughing of part of the rectal wall owing to its being nipped between the child's head and the promontory of the sacrum during a prolonged second stage of labour. Strictures due to this cause often do not show much evidence of their presence until a year or more after the time at which they were caused. I have seen strictures from this cause so complete that only a probe could be passed through the opening. Severe stricture of the rectum may also result from complete rupture of the perineum, especially if this has been badly treated at the time.

Since the introduction of Whitehead's operation for piles quite a number of strictures at the anal orifice have been met with as the result of this operation.

Syphilitic Stricture.—At one time most strictures of the rectum were supposed to be the result of syphilis, and this is still often stated as a common cause in surgical text-books. While it cannot be denied that such cases occur, stricture caused by syphilis is certainly a very rare condition. At St. Mark's Hospital no undoubted case of syphilitic stricture of the rectum has been met with in the last ten years.

Treatment of Non-Malignant Stricture.—*Dilatation.*—The very greatest care must always be taken in dilating a rectal stricture, for there have been a considerable number of accidents from this cause. The danger lies in splitting the stricture and so allowing septic material to reach the cellular tissue outside the bowel-wall. The greatest danger is connected with strictures which involve that portion of the rectum above the peritoneal reflection, as the bowel-wall is very thin here, and, if it is split, general peritonitis will almost certainly result.

There are a great number of rectal dilators, but the mechanical type of dilator should never be used. The best kind of dilator is the flexible Wales bougie. The graduated metal dilators similar to those used in dilating the os uteri are another good type.

Method of dilating a High-Lying Stricture in the Rectum.—The patient should be on the left side with the knees drawn up. A Wales bougie of a size which will pass the stricture fairly easily, should be warmed in hot water and thoroughly greased all over with vaseline. It should then be passed in until the probe end is felt to pass the stricture, a finger being passed along the bougie, if necessary, to make certain that the end has entered the stricture. The bougie should then be pressed very slightly in, only moderate force being used. Considerable patience is often necessary, and on no account should the operator be tempted to use force. When the bougie is felt to slip through the stricture it should be left in for a few minutes, and then withdrawn, and the next largest size passed. The stricture should only be dilated a small amount at one sitting. On each occasion the dilatation should be started with the smallest size and be taken a little farther each time. In dealing with a very obstinate stricture it is a good plan to tie the bougie in, giving the patient some sedative like morphia to allay the pain.

It must be insisted upon that dilatation of high-lying strictures in the rectum is a very dangerous operation, and must be carried out with the greatest care and patience, and if possible, only by those who have had previous experience of such cases.

When the stricture is within $2\frac{1}{2}$ inches of the anus metal dilators may be used. These should go up in size by $\frac{1}{16}$ inch, and should be used in the same way as the soft bougies. When once the stricture has been thoroughly dilated the patient should be instructed how to keep it dilated by the passage of a bougie daily and should be warned on no account to neglect this.

Fibrolysin injections are sometimes of use in addition to the use of bougies, as this drug seems to have a softening influence upon the fibrous tissue.

Operative Treatment. Internal Proctotomy.—This operation is comparable to that of internal urethrotomy. The stricture is usually divided posteriorly with a blunt-pointed bistoury, or it may be incised in several places and then dilated with bougies. The operation is completed by the insertion of a large rectal vulcanite tube which is tied in by means of tapes. The tube should be removed daily and the bowel thoroughly washed out with some antiseptic lotion. Although this operation gives excellent results in some cases, it is difficult to carry out aseptically, and there is always a risk of perirectal cellulitis.

Complete Proctotomy.—This consists in making a large linear posterior incision through the stricture and all the tissues external to it. Owing to the free drainage which results from this large incision the risks of sepsis are reduced to a minimum. But the necessarily large wound takes a long time to heal, and there is always a slight risk of loss of control.

Excision.—In recent years excision of rectal strictures has become much more common, and very excellent results have been obtained in suitable cases. In dealing with strictures near the anus a modification of Whitehead's operation for piles is sometimes all that is necessary. With strictures higher up an operation for resection of the stricture, similar to that performed for malignant disease, sometimes gives very good results.

Colotomy may be called for in dealing with rectal stricture in two cases :

(1) Temporary colotomy may be performed in order to deflect the faeces and enable ulceration to heal up before dealing with the stricture by operation.

(2) A permanent colotomy may be established. Although patients naturally object to an artificial anus, they are infinitely more comfortable with this than they could possibly be with a tight and non-dilatable stricture.

MALIGNANT DISEASE OF THE RECTUM

Early Symptoms.—One of the earliest symptoms of cancer of the rectum is a sense of discomfort in the rectum, and difficulty in getting the bowels properly relieved. The pain complained of in these cases varies considerably and in many it is altogether absent. Pain in the sacrum or in the lower abdomen is sometimes felt. Diarrhoea is an early common symptom and is often deceptive. It frequently happens that the diarrhoea only occurs occasionally, and may then be readily attributed by the patient to some error of diet. When a patient, especially an elderly one, complains that during the course of a few weeks or months she has had several attacks of diarrhoea without any very definite cause, we should view the case with grave suspicion. Slight diarrhoea on first rising in the morning is a symptom which should always give rise to a suspicion of cancer of the bowel.

Bleeding from the bowel is a common and often early symptom of cancer of the rectum, owing chiefly to the fact that the bowel is fixed and traumatism from the passage of faecal material readily occurs, giving rise to ulceration of the growth at an early stage. In cancer of the more mobile colon, however, traumatism does not so readily occur, and chiefly for this reason blood in the stools is not a common symptom of cancer of the colon. Although blood in the stools is not commonly detected when the stools are examined in the ordinary way, it can often be found if a microscopical examination of the faeces is made.

Examination of the Patient.—This may be considered under three headings, all of which are important: examination per rectum, palpation of the abdomen, examination of the stools.

It is first of all essential to get the bowel empty as far as possible, for not only will this facilitate the rectal examination, but it will also render abdominal palpation much easier. It is, of course, not possible to feel directly a growth high up in the bowel by means of a finger in the rectum ; but a bi-manual examination with a finger in the rectum and the left hand on the abdomen will often enable a growth to be felt which is otherwise out of reach.

By far the most important and valuable method for the diagnosis of high growths in the rectum is examination with the electric sigmoidoscope, and, whenever possible, this method of examination should be utilized.

Indications for Operation.—This is one of the most difficult problems the rectal surgeon has to solve. Not only must he decide whether the operation shall be performed or not, but also which operation will give the patient the best chance of a successful result with the minimum of risk. The decision will depend upon the conditions present. If the growth is comparatively small and of fairly recent origin, if it is confined to the lower rectum or the ampulla, and if the patient is not more than fifty-five and in good health, there can be no possible question that a free excision of the growth is the proper treatment, and that it should be carried out as soon as possible. If, on the other hand, the growth is situated at the upper end of the rectum, if it has already reached a considerable size and has become more or less fixed, and if the patient is over sixty years of age and not in very good health, there can be no doubt that any attempt to excise the growth is absolutely contra-indicated.

The general condition of the patient is a factor of the utmost importance, more especially when we have to deal with growths which will necessitate an abdomino-perineal excision or excision of the entire rectum. The operation is necessarily a severe one, and the patient whose general health is bad will have but a poor chance of surviving it. Well-marked arteriosclerosis, chronic disease of the kidneys, or a feebly-acting heart are all contra-indications to operating. But the most serious contra-indication, in my opinion, is obesity. Fat patients are bad subjects for any kind of operation, but in the case of rectal excision the presence of large quantities of fat adds so enormously to the difficulties of the operation that it renders the patients most unsuitable subjects.

Other things being equal, the operation for excision of the rectum is far less dangerous in women than in men. The operation is nearly 50 per cent easier in the case of women. Women stand the operation better, and their recovery is usually more rapid. This is due to several causes. In the first place the pelvis is considerably wider in women, and there is consequently more room. The rectum is a somewhat more movable structure in women than in men. Another important factor is that in women the uterus and vagina lie in front of the rectum, and injury to these structures is not a serious complication, while their separation from the rectum is comparatively easy.

In considering the advisability of operation the question of age is not so important as it used to be. Since I have operated by the shockless method, using a combination of local anaesthesia and general analgesia (with gas and oxygen), I have found it possible to operate upon quite elderly patients, and to do long and extensive operations quite safely. As an instance, I recently successfully performed a complete excision of the rectum, using this method, on a lady of seventy-three, and she made a rapid and uneventful recovery. Age alone is therefore not necessarily a bar to operation, provided that this method of anaesthesia is used and that the patient can be operated upon under the best conditions.

This form of combined anaesthesia has given such good results that I now use it in all cases of excision of the rectum. Quite apart from the increased comfort of the patient it has, in my opinion, reduced the dangers of the operation by quite 50 per cent.[1]

Choice of Operation.—The question as to which operation is the best for the removal of the rectum is one on which there is much difference of opinion ; but the general tendency of recent years has been to advocate much more extensive operations, and to advise that the abdomino-perineal operation shall be performed in the majority of cases. This is in accordance with the results of recent study of the lymphatics of the rectum, which lead us to believe that the more freely these lymphatic areas in the neighbourhood of the rectum are removed, the better chance is there of the subject being free from recurrence. I propose to describe here three methods of operating for cancer of the rectum : (1) local excision ; (2) perineal excision ; (3) abdomino-perineal excision. It must be understood that I do not advocate local excision of growths in the rectum except in cases where it is impossible to perform any more extensive operation, and the choice lies only between this and doing nothing.

Operation of Local Excision.—The patient is placed on the left side, in the semi-prone position, with the buttocks on the edge of the table and with the knees well drawn up. An incision is made in the middle line, starting at the lower part of the sacrum and finishing an inch behind the anus. The tissues are then freed from the coccyx and each side of the coccyx is exposed. The fibres of the glutei which arise from it on either side are freely divided, and the tissues separated from its front surface until the coccyx remains attached only to the sacrum. After the coccyx has been removed the wound is deepened, and the rectum, having been defined, is freed as much as possible and drawn up into the wound. Forceps are attached to it to act as retractors, and it is opened well to one side of the growth, so that the incision may be through healthy tissue. That portion of bowel-wall containing the growth is then cut away, a good wide margin of healthy mucous membrane being left round the growth. There is generally free haemorrhage at this stage of the operation, and a number of vessels have to be picked up with the pressure-forceps and tied off. The wound in the rectal wall must now be closed, and should, if possible, be sutured in a direction from side to side, so as to prevent any narrowing of its lumen.

Perineal Excision.—The patient is placed in the lithotomy position, and a small hard cushion is put under the sacrum so as to raise the buttocks well above the table.

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[1] A full description of the technique will be found in "Anoci-Association," by Crile and Lower, and "The Shockless Operation," by the present author, *Lancet*, June 23, 1916.

The first step in the operation is to dissect up a cuff of mucous membrane from the anal canal, for about 2 inches, in the same way as in Whitehead's operation. Scissors are used for this, and are then put aside and not again used. The rectum is then either closed by a clamp, and the portion of mucous membrane below the clamp sterilized with pure carbolic, or is closed with a purse-string suture. An incision is now made through the sphincters posteriorly, and carried backwards to a little beyond the base of the coccyx, which is next removed. The posterior rectal space is then opened up, and the rectum and all the glands, cellular tissue, and lymphatics peeled off the sacrum with the finger, in one piece. The levator ani on each side is pulled down by passing a finger behind the muscle, and divided. Attention is then turned to the separation of the rectum in front from the vagina. As soon as the peritoneal cul-de-sac is reached, it is opened, and the attachments of the peritoneum to the rectum divided, first on one side and then on the other, care being taken to keep as close to the rectum as possible, so as to avoid injury to the ureters. The rectum is now free in front and at the sides, except for some fascial attachments which are easily divided. The rectum will now come down several inches, and will be attached only by the meso-rectum. The next step is to divide the meso-rectum. This is best done by applying a clamp to it as near as possible to the sacrum, and dividing the meso-rectum in front of the clamp. The rectum now comes down freely, and the sigmoid comes into view. The next step is to divide the meso-sigmoid, until a portion of the sigmoid is reached which has a sufficiently long mesentery to reach the anus easily and without dragging. This may be anywhere from 3 inches to 6 inches above the junction of the sigmoid with the rectum. The meso-sigmoid is clamped, and divided until a sufficiently long piece of mesentery is found. The whole of the rectum and growth are now right outside the wound, and the next step is to repair the parts. First the clamps must be tied off, and this is sometimes difficult, as they are a considerable distance from the surface, and it is not easy to pass a ligature round their upper ends. The peritoneal floor of the pelvis is then restored by stitching the peritoneum all round to the sides and front of the sigmoid. Some sterilized gauze is next placed in the wound to protect the peritoneum, and its end brought out at the posterior part of the wound. The rest of the wound is sewn up completely, and the sphincters carefully brought together and sutured.

If the sphincters are involved, and it is necessary to remove them, a preliminary colotomy should be performed, and later, when the excision is done, after removal of the rectum and growth, the end of the sigmoid is closed up and replaced in the pelvis, the perineum being completely stitched up, and no opening left.

Abdomino-Perineal Excision.—This operation is one of the most formidable in surgery, and it is essential that it should be carried out under the most favourable auspices as regards the preparation, facilities for performing the operation with the least possible delay, and the after-treatment of the patient.

The patient is first placed in the full Trendelenberg position, and arranged so that a good light can be thrown into the lower part of the pelvis. The abdomen is

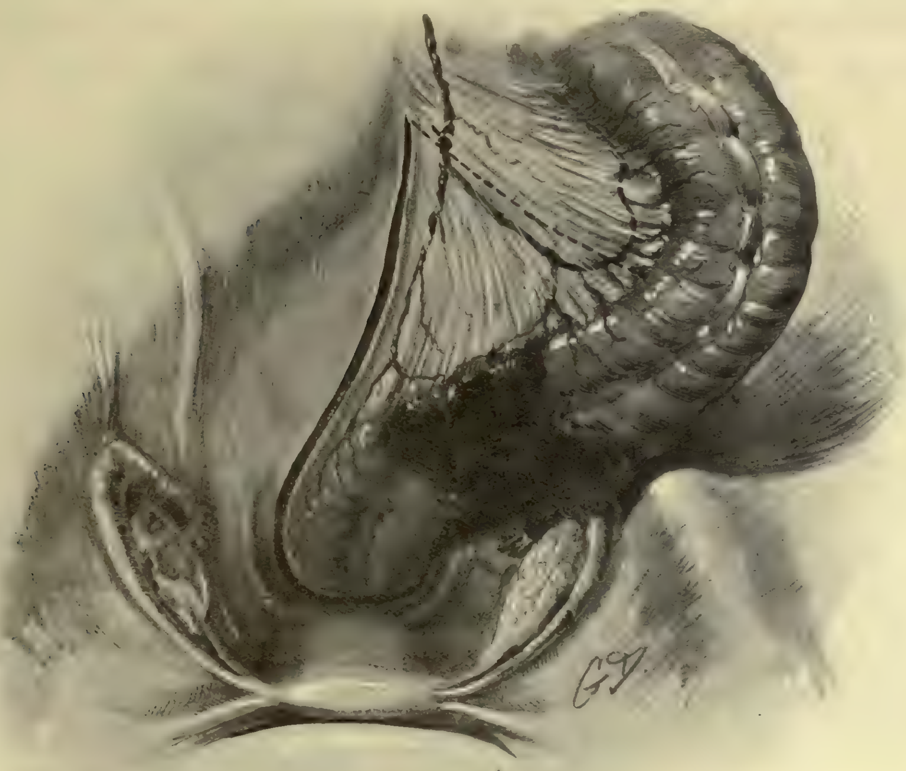

FIG. 58.—Abdomino-perineal excision. Division of peritoneum and ligature of main vessels. (1st stage.)

opened in the mid-line from the symphysis pubis to a little above the umbilicus. The growth is then carefully examined, and the exact steps of the operation planned out. If the surgeon decides to bring down the sigmoid, so as to re-establish the bowel in the normal position, the pelvis is packed off with gauze, and the sigmoid drawn as far as possible out of the wound. The meso-sigmoid is put on the stretch by the assistant, and the surgeon, by blunt dissection with a pair of dissecting forceps, searches for the inferior mesenteric artery. This vessel is then tied and divided above the origin of the lower sigmoid arteries, the veins being tied off at the same time. The remainder of the meso-colon should then be divided back to the sacrum (Fig. 58). The bowel is next turned over on the right side and the left ureter defined (Fig. 59). This is often a matter of considerable difficulty. The ureter should not be dissected out, as this might endanger its blood-supply; but it must be kept in view during the whole of the first stage of the operation, and carefully located to prevent any possibility of injuring it. Should the growth extend over towards the right side of the pelvis, the right ureter should similarly be defined. As a rule, however, there is little danger of damaging the right ureter. The packing is now removed from the pelvis, and the surgeon begins to divide the peritoneal floor on each side of the meso-sigmoid and rectum, passing between the rectum and bladder at the bottom of the pelvis. This is best done with a long pair of scissors with cross-over handles. Everything is cleared right down to the bone behind the bowel,

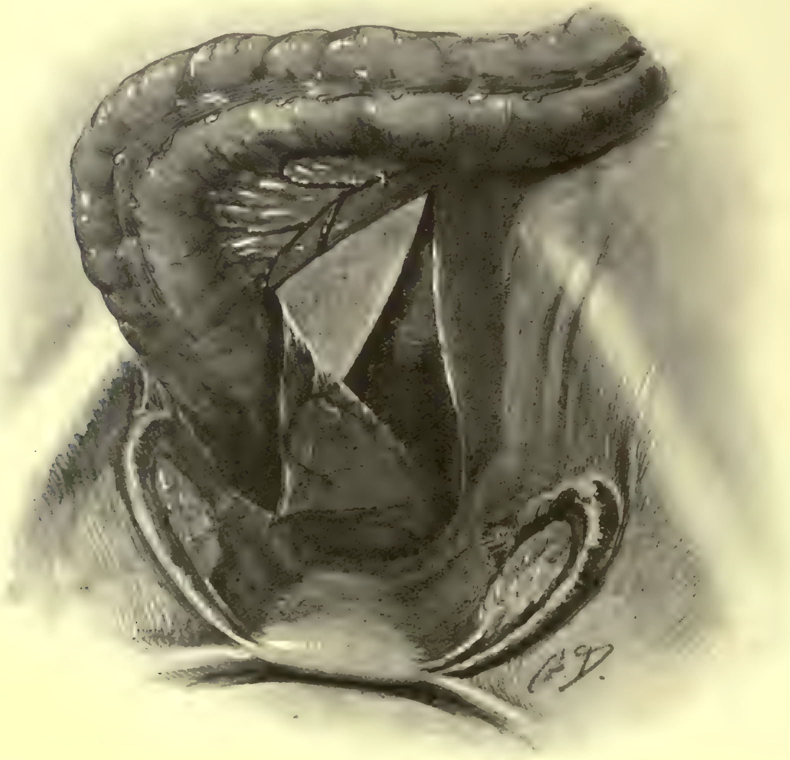

FIG. 59.—Abdomino-perineal excision. Vessels ligatured and peritoneum completely divided. (2nd stage.)

each side to mark the point of division of the sphincter muscle, as this will assist in restoring the muscle later. The coccyx is next removed.

The wound is then deepened until communication is established with the wound in the pelvic floor which has already been made from above. The levatores ani on either side are divided well away from the bowel-wall, and the rectum separated, together with all the fat and other tissues as far as the bone behind and at the sides. The loose bowel in the floor of the pelvis is now dragged out through the posterior wound. A large loop of bowel will come out, consisting of the upper part of the rectum and the lower part of the sigmoid flexure. This is held to one side by an assistant, and a good light is thrown into the deeper parts of the wound. The remaining attachments of the rectum in front are then carefully separated from above downwards, this being very much easier than separating the bowel from below. Finally, the lower portion of the rectum, which has previously been closed by suture, is carefully dissected out of the sphincter on either side (Fig. 62). The rectum will now be free, and will only remain attached to the sigmoid by its upper end. The bowel is then placed back in position, so as to see at what point it must be divided in order to restore the anus to the proper

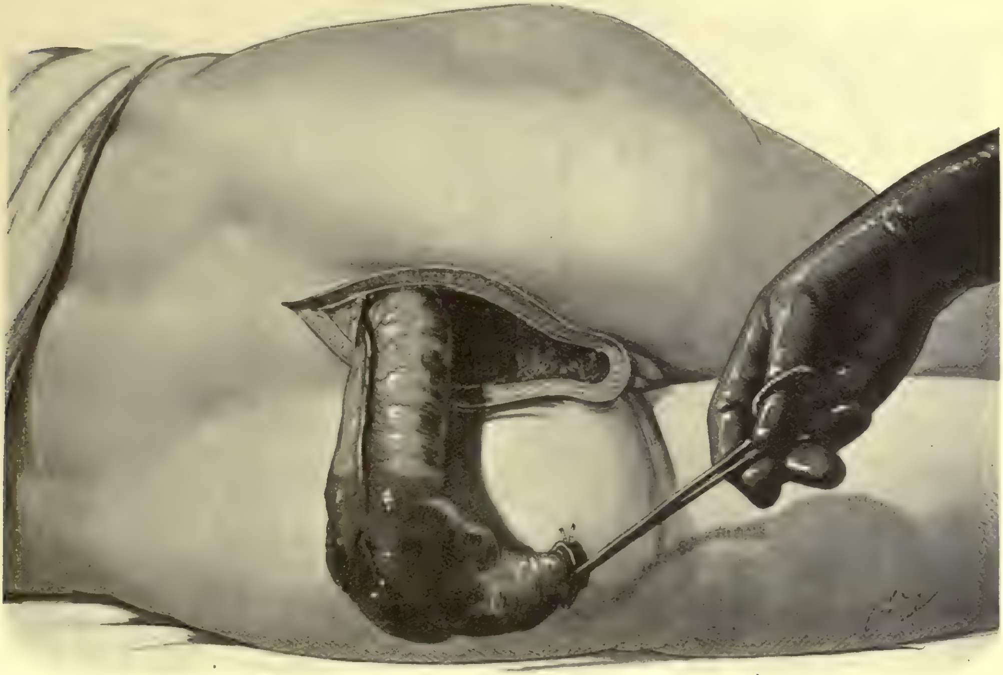

FIG. 62.—Abdomino-perineal excision. Bowel completely detached without having been opened.

position (Fig. 63). There should be sufficient bowel to reach the anus after at least a foot consisting of rectum and sigmoid has been removed. The next step in the operation is to attach the bowel loosely to the muscular structures of the anus. The sutures should take up the peritoneal and muscular walls of the sigmoid and the tissues just around the anus. A few stitches to prevent retraction are all that is necessary. A large tube is then put into the posterior wound and brought out just below the stump of the sacrum. The posterior wound is then closed with fish-gut sutures. The bowel is now divided about an inch away from the skin, where it emerges from the anus, and the mucous membrane is loosely stitched to the skin away from its edge, as in the previously described operation, or a Paul's tube is tied into the stump.

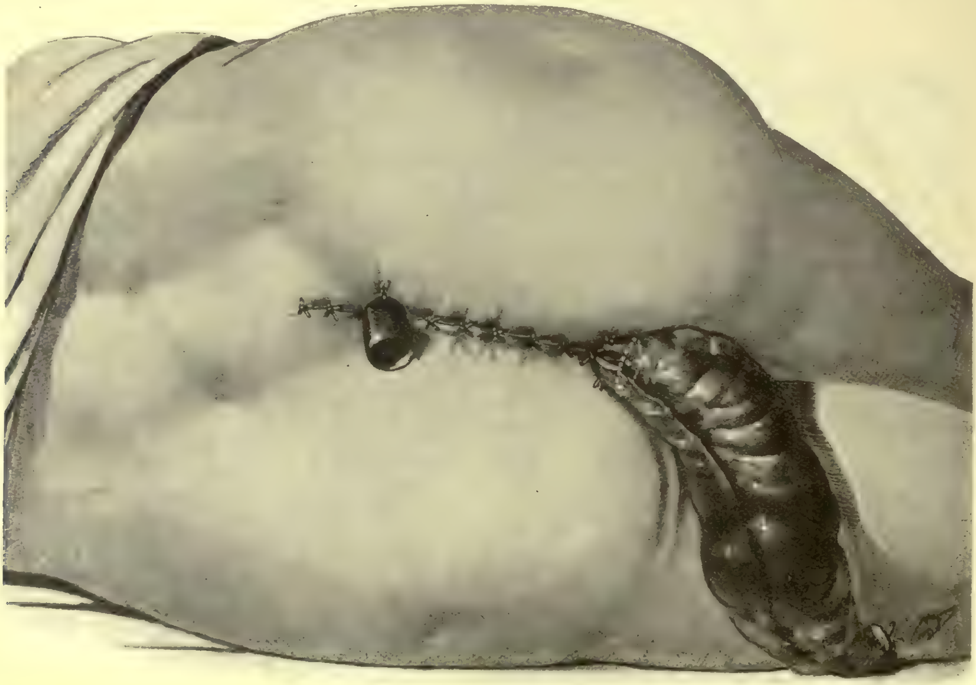

Fig. 63.—Abdomino-perineal excision. Final stage. Posterior wound closed and bowel containing growth ready to be cut off. Point of section marked by dotted line.

Alternative Method of Performing the Final Stage of the Operation.—The following method may be used where it is advisable on account of the patient's general condition to shorten the operation as much as possible. It is also useful when there are doubts as to the vitality of the bowel that has been brought down. After the completion of the first or abdominal stage of the operation, the patient is placed in the semi-prone position as already described, and an incision is made from the end of the sacrum to a point an inch behind the anus. This wound is deepened and the coccyx removed. The loose bowel containing the growth in the posterior pelvis is then drawn out of the wound in the form of a loop as shown in Fig. 64. Vaseline gauze is packed lightly into the wound and the dressings are applied. The loop of bowel is left in the dressings and the patient is sent back to bed. Some days or a week later the patient is again given an anaesthetic (or this part of the operation can be done without an anaesthetic as the parts are insensitive); the loop containing the growth is cut away and an end-to-end anastomosis performed

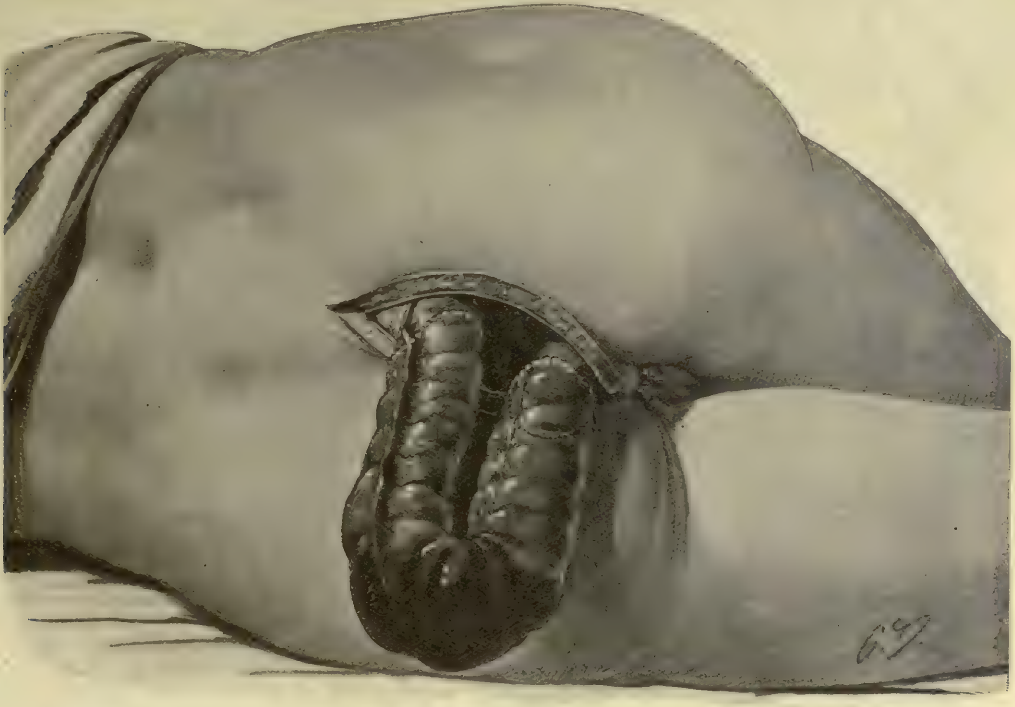

Fig. 64.—Abdomino-perineal excision. Loop of bowel including growth drawn out of posterior wound. The dotted lines show points of division where bowel is to be joined up.

between the upper part of the bowel and the last inch or two of the rectum as shown in Figs. 64 and 65. Care must be taken to use only healthy bowel, and to stitch the mucous membrane closely together. A large-calibre drainage tube should be passed from the anus up through the line of junction and left in for some days. It is better to cut the sphincter posteriorly to prevent spasm and pain from the pressure of the tube. The deep parts and skin should be closed over the line of junction with stitches, but the upper part of the wound must be left open or adequate drainage provided in some other way.

The bowels can be relieved before performing the second stage by opening the end of the loop above the growth.

This technique very much reduces the time necessary for the operation, 20 to 30 minutes being saved. I have performed the whole operation with this method of finishing in 56 minutes.

Abdomino-Perineal Excision with Colotomy.—The technique of this operation is the same as for the abdomino-perineal operation already described, except that in this case no attempt is made to restore the bowel with an opening in the normal situation, but instead a permanent colotomy is performed. The abdomen is opened in the same way as previously described. The sigmoid is drawn out of the wound, and the point at which the bowel is to be divided is decided upon. This should be as high up as possible, the necessity of not having any tension at the colotomy, and of keeping a good blood-supply to the upper stump always being borne in mind. The bowel is now packed round with towels, so as to shut off the abdominal wound as completely

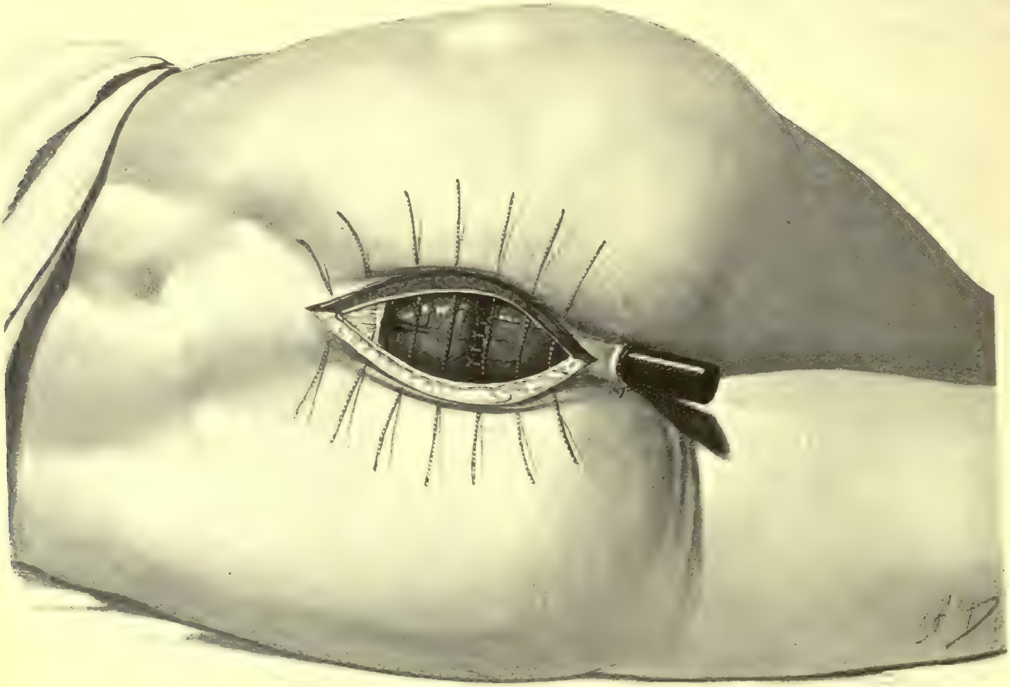

Fig. 65.—Abdomino-perineal excision. Final stage, where the loop of bowel has been cut off (at points shown in Fig. 64). Ends of bowel joined up and wound about to be closed over the join. Free drainage should be provided. In addition to drainage of the wound (not shown) a large tube is put in the rectum through anus. *N.B.* This joining up of the rectum is done some days later than the major operation.

as possible. The bowel is firmly clamped by means of two clamps applied close to each other. It is then cut through between the clamps, and the ends cauterized with a Pacquelin cautery. The clamps are then removed, and both ends of the bowel carefully invaginated with sutures.

The operation is now proceeded with in exactly the same way as already described. The lower stump of bowel is pushed down below the pelvic floor, and the pelvic floor is carefully stitched over it, care being taken not to let any of the stitches pick up bowel beneath, which would cause great difficulty during the second stage. Before the abdomen is closed, an incision is made through the abdominal wall to the left side of the main incision, and through this the upper end of the bowel is drawn. The stump of bowel is then loosely stitched to the skin, so as to prevent its retracting, and left closed.

GYNAECOLOGICAL OPERATIONS

1. Technique
2. Anaesthetics
3. Ovariotomy
4. Hysterectomy
5. Operations on the Gravid Uterus
6. Intestinal Complications
7. Vaginal Coeliotomy
8. Minor Operations
9. Fistulae of the Genital and Urinary Tracts
10. After-Treatment

TECHNIQUE

By Thomas Watts Eden, M.D., F.R.C.S.E.
(London)

The performance of a surgical operation resembles the conduct of a military campaign. Special knowledge and prolonged training are required on the part of the principals—the surgeon and his assistants; the implements employed must be familiar to those who use them, and must be got ready with minute and scrupulous care; the environment must, if possible, be selected to the greatest possible advantage. The actual operation demands skill, courage, prudence, and resource; the campaign is not ended with the closure of the wound, but must be pursued without slackening until the decisive result, viz. the recovery of the patient, is assured. No greater mistake could be made than to regard an operation as a *tour de force*; it is in reality a prolonged encounter with dangers and difficulties which are for the greater part impalpable. To an unversed spectator an operation may appear as a mere display of rapid, manipulative dexterity. To a fellow-craftsman, preparations, precautions, safeguards, and the organization of forces are the points by which the quality of operative work is mainly to be judged.

The actual performance of an operation is learned by watching or assisting others of greater experience, by practising it, in some cases, on the cadaver or on animals, and by repeatedly performing it. Yet operators of equal experience differ widely in their methods, which are, to a certain extent, an index of their character. The surgeon who is careful and methodical often achieves as good results as one whose work is characterized by dexterity and rapidity rather than by carefulness; it would be purposeless for the one to emulate the methods of the other, each must work upon the lines which are natural to him.

When operating, four considerations are ever present to the surgeon's mind: (1) that he must carefully exclude all possible sources of infection, (2) that he must handle living tissue gently, (3) that he must incur no unnecessary risk to life, (4) that he must waste no time over his work. Apart from the first named it is difficult to say which is of greatest moment as a factor of success. It is without doubt wrong to sacrifice to speed either of the other considerations. On the other hand, the surgeon who, from indecision, lack of skill, or want of concentration unnecessarily prolongs his work is doing his patient a serious disservice. The rapid worker must, however, be capable of pausing when necessary ; unexpected and uncommon conditions may be encountered, calling for a change of plan or a departure from the usual procedure, and time for reflection under such circumstances is never wasted.

The surgeon should strive to do his work calmly, and even in moments of stress to conceal the perturbation which he may feel. He will then be served in the same spirit by his assistants. An agitated surgeon necessarily implies a staff or ‘ team ’ thrown out of gear, and therefore in a condition to commit mistakes of technique which may pass unnoticed, and lead to disaster.

Under ideal conditions the surgeon and his assistants understand one another, they have co-ordinated their work by practice, each knows his part, and does it at the right moment, and in the right way. Herein lies the chief secret of rapid operating. Unfortunately such conditions are not always attainable. In this country hospital surgeons are engaged, for the greater part of the time, in training inexperienced assistants who are changed every few months. ‘ Team-work ’ is therefore not seen to advantage, and operative work undoubtedly suffers in consequence. Yet it is not wise for the surgeon to acquire a habit of complete reliance on assistants. He is personally responsible for everything that goes on, and one of his pre-occupations is to watch the work of his team when he is operating. The extent to which surgeons are accustomed to depend upon assistance is variable ; some first-class operators do practically everything themselves, leaving to their assistants only the least important details. Other surgeons share the operation with their chief assistant, and such work, well carried out, is very attractive to watch, and yields unsurpassed results. As a general principle the number of persons actually engaged during an operation should be limited to the fewest possible. Most abdominal operations can be performed, if necessary, by the operator and a single assistant ; considerable loss of time occurs in threading needles and managing swabs, but it can be done if required. Each person engaged is a possible source of sepsis, and the less experienced the assistants the fewer should they be.

Many abdominal operations, such as the removal of an uncomplicated fibroid or ovarian tumour, are extremely simple, and can be carried out by a routine procedure which hardly ever calls for variation. When, however, the conditions present are complex or unusual in character, it is worth while for the surgeon to give some preliminary thought to his plan of campaign, *i.e.* to consider in what fashion his usual procedure should be modified. In order to do so the surgeon must cultivate the art of clinical diagnosis. It must be admitted that many operators are content to make their diagnosis by direct examination after opening the abdomen. This saves trouble, but does not save operative time; it tends to transform the surgeon from a scientific observer of disease into a mechanic skilled in the removal of parts of the body which can be dispensed with. If, on the other hand, he trains his faculties to diagnose with approximate accuracy the nature and extent of the morbid conditions, he can also map out in advance the details of the operative procedure which is best calculated to attain his ends in the most effectual manner. A wrong operation, skilfully performed, is a surgical failure, although none but the operator himself may know it. The ultimate test of all operative work is not the survival of the patient, but the measure of relief to suffering or disability which it ensures. The uncertainties of diagnosis in intra-abdominal disease are notorious and discouraging; exploratory operations will probably always be numerous, but alike when palpable lesions are found, or where only symptoms are present, a serious effort should be made to estimate their nature and extent before operation.

An examination under anaesthesia should be made in all cases where the diagnosis is in doubt; this can be done by the surgeon immediately before commencing the operation, and does not then necessitate an anaesthetic being administered twice. In the case of pelvic swellings complete muscular relaxation is always of the greatest assistance in making out the relations of the parts.

Pre-operative abdominal diagnosis will often require the assistance of the clinical laboratory in radiographic and in bacteriological examinations, in the more complex urinary tests, and in the examination of the blood.

From what has been said it will be clear that even where the diagnosis has been made, the surgeon has still many matters demanding his attention before he comes to the operation at all. Of these, one of the most important is the preparation of the patient for the ordeal, and this subject may be considered first.

Preparation of the Patient for Operation

Operations of major importance are borne much more easily, and are attended with less post-operative suffering, and less risk to life, when time is available for careful preparation of the patient. In certain acute conditions all other considerations give way to the question of time, *i.e.* to the necessity of dealing promptly with a lesion which can only be successfully attacked in its early stages. In all other cases hurried preparation is to be avoided. Women of nervous and excitable temperament often ask that they should not enter the nursing home or hospital until a few hours before the operation. This is a mistake, for after the patient has had time to get accustomed to her surroundings and to the nurses, she becomes calm and reassured, and can face the operation in an equable frame of mind.

The psychical condition of the patient is a factor of some importance. Fear greatly increases the difficulty of inducing anaesthesia, and diminishes the power of resistance of the nervous system to shock. Crile states that definite physical changes can be observed in the brain-cells of animals that have been subjected to the influence of fear.[1] Emotional disturbances of all kinds are exhausting, and mental tranquillity is, without doubt, an important surgical asset in the subject of a serious operation. Some surgeons (Crile, Jayle) attach so much importance to this point that they administer nitrous oxide gas to their patients on two or three trial occasions, and do not allow them to be told when the operation will actually take place. Thus they become accustomed to the induction of anaesthesia, and the mental distress of awaiting the known hour at which the operation is to take place is avoided. These precautions, while serviceable in exceptional cases, obviously cannot be carried out in routine surgical work.

Whenever it is possible a patient should be kept for at least thirty-six to forty-eight hours under observation before the operation takes place. The diet should be simple and restricted ; full meals and rich food are to be avoided, so that the digestive organs may be given as little work to do as possible. Some surgeons (Pauchet) insist upon a fast of two or three days before abdominal operation, the patient being given large quantities of fluid, such as infusions of dried fruits, *e.g.* raisins, and infusions of herbs, weak tea, etc., and no solid food. In cases of obesity this fast is prolonged by Pauchet for two or three weeks before the operation is performed. Alcohol and coffee should be withheld, as excitants of nerve-centres.

It is important that the bowel should not be loaded when an abdominal operation is performed. The desired condition of the intestine is best produced, not by drastic purgation on the night before the operation, but by the regular use of laxatives for several days previously. Purgation is exhausting, and induces a condition of nervous distress which is exactly what the surgeon desires to avoid. An aperient need not be given during the last twenty-four hours if the bowels have been kept freely open ; an enema can be used twelve hours before the operation to ensure the evacuation of the lower bowel. If only a day is allowed for preparation, a full dose of castor oil should be given, the stomach being empty, at least twenty-four hours before the operation. Castor oil is the most reliable of the aperients, acting upon all parts of the intestinal canal.

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[1] *Lancet*, July 5, 1913.

The importance of careful preparation of the alimentary canal is twofold: (1) when the coils of bowel are not distended operative manipulations within the abdomen are facilitated; (2) stagnant intestinal contents are a source of danger in that the organisms they contain are probably of higher virulence, and therefore more to be feared if they obtain access to the peritoneum.

In cases of intractable vomiting, especially when associated with intestinal obstruction, the stomach-contents are infective, and stomach-lavage should be practised immediately before the anaesthetic is administered.

Another frequent source of infection, especially in patients of the hospital class, is the mouth. Oral sepsis is a cause of chronic dyspepsia, of colitis, and under anaesthesia it may lead to septic pneumonia, from entrance of saliva into the air passages. Carious teeth, especially when associated with suppuration in the gums, are accordingly a definite source of danger in operative work which should not be overlooked.

During the time the patient is under preliminary observation a general survey of the circulatory, respiratory, nervous, and urinary systems should be made. The subjects of exophthalmic goitre are difficult for all forms of anaesthesia; chronic bronchitis is a contra-indication for inhalation anaesthesia, and the intra-spinal method should be adopted in preference. A well-compensated valvular lesion of the heart is of little importance; failure of compensation, indicating myocardial insufficiency, is of serious consequence, and contra-indicates inhalation anaesthesia, or prolonged and severe operations. Epileptics take an anaesthetic badly, but the insane are readily anaesthetized and bear operations well.

The urine should be investigated in order to determine the absence of chronic nephritis, or of inflammatory changes in the urinary passages, such as pyelitis and cystitis. Glycosuria is of no importance, but diabetic subjects show only feeble resistance to shock; ether is the anaesthetic of choice owing to the tendency of chloroform to affect the liver-functions and produce a condition resembling acidosis. Bright's disease is not a contra-indication to operation except in its advanced stages, but calls for careful preparatory treatment and dieting. Pre-existent urinary infection may lead to serious complications in cases of panhysterectomy; a certain amount of damage to the blood-supply of the bladder and of the ureters usually results from a Wertheim's hysterectomy, and in consequence a transient cystitis occurs in a considerable proportion of cases during convalescence. If the bladder is already infected the results may be much more severe, and any unusual operative injury to the bladder or ureter becomes a very grave accident, partly because widespread sepsis may ensue, and partly because repair of the injury is much less likely to be successful if the urine is infected. Therefore careful preliminary treatment by the administration of urinary antiseptics, and by irrigation of the bladder should be practised in such cases.

Anaemic or debilitated subjects may, with benefit, be given hypodermic doses of strychnine for three or four days before operation ; $\frac{1}{30}$ of a grain may be given thus twice a day.

In arranging a gynaecological operation the surgeon is often hampered by the unexpected appearance of menstruation, the period coming before its time in consequence of nervous strain, or possibly from free purgation being employed. Vaginal plastic operations clearly should not be performed during menstruation. With abdominal operations the case is different; the greater number of these can be safely undertaken, but exception must be made in the case of myomectomy. The increased vascularity of the uterine wall adds to the technical difficulties of arresting bleeding in this operation, and further the uterine cavity is frequently opened in myomectomy through the endometrium being torn. Bleeding from the torn mucous membrane will naturally be much freer in the menstruating than in the non-menstruating uterus.

The night before operation a hypnotic may be given with advantage to nervous women, or to those who sleep badly. Nothing should be taken by the mouth for four to six hours before operation, and anything given at that time should be easily absorbable fluid, such as weak tea without milk, or beef-tea, or clear soup. For the reasons already given, an enema should not be administered during the last few hours of preparation ; it often causes faintness and exhaustion, while the indication is to maintain repose of body and mind as far as possible. In operations on the pelvic organs it is important that the bladder should be empty, and the patient should pass water naturally immediately before the anaesthetic is begun. Routine catheterization is unnecessary. Three-quarters of an hour before the operation a narcotic dose should be administered hypodermically : the author's practice is to give $\frac{1}{120}$ gr. of atropine and $\frac{1}{6}$ of morphia; the dose may, however, be increased to $\frac{1}{100}$ of atropine and $\frac{1}{4}$ of morphia, and $\frac{1}{100}$ of scopolamine may be combined with it in the case of physically robust persons. The first-named dose is quite sufficient for women of average physique, with the exception of those accustomed to the use of morphia, when, of course, larger doses will be required. The advantages of preliminary narcosis from the point of view of anaesthesia will be dealt with in another place.[1] It is also of great advantage in producing calm and drowsiness during the hour immediately preceding the operation, a time when so many women suffer acutely from morbid apprehension of what is to come. They take the anaesthetic quietly, and pass into sleep without a preliminary stage of excitement which is otherwise so apt to occur in the case of agitated subjects.

No apology is needed for insistence upon careful attention to detail in preparing the patient for an operation. While the immediate success of the operation, *i.e.* the recovery of the patient, is not in all cases much influenced by preparation, under certain conditions this is so. And in all cases, the effect of careful preparation upon convalescence is unmistakable ; post-operative distress is largely assuaged, shock is diminished, and the duration of convalescence is shortened.

THE ORGANIZATION OF AN OPERATION

A great deal of the work upon which the success of an operation depends is necessarily delegated by the surgeon to others. He is, however, responsible to the patient for the proper performance of this important work, and he must consequently organize and direct all that does not actually pass through his hands.

Operative technique is necessarily elaborate in character, and involves the careful consideration of innumerable details. Its main object is the *prevention of infection*, but others of the greatest importance are the *prevention of post-operative shock*, and the *safe conduct of anaesthesia*. The latter subject will be considered in this work in a separate article, and we are therefore not concerned with it here. The prevention of shock may be secured to a large extent by certain precautions carried out during the operation, which will be detailed later on. The prevention of infection demands the most careful preparation of all the materials used during the operation, and here the surgeon must depend to a great extent upon the skilled co-operation of his assistants.

Prevention of Infection

To exclude bacteria completely from the field of operation is now recognized as impossible ; it was the aim of Listerian technique, as exemplified in the carbolic spray, and later, in the continuous irrigation of the field of operation. Surgeons have now learned that complete sterilization is an impracticable ideal as regards two important factors which have always to be reckoned with, viz. the atmosphere and the body-surfaces. The atmosphere can be neither excluded nor rendered bacteria-free; the presence of living, breathing persons in a room taints the air it contains; while in talking, coughing, and sneezing innumerable minute germ-laden particles of moisture are expelled, which float for a time, and then settle upon any surface of contact. Healthy skin and most mucous membranes contain a numerous and varied bacterial flora, which cannot be eradicated without at the same time destroying the tissues. The efforts of the surgeon are accordingly directed to diminishing their numbers and temporarily suspending their vitality.

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[1] See page 377.

For operative purposes the skin and the mucous membranes are all to be regarded as infected surfaces which require preparation. The mucous membranes of the uterine body and Fallopian tubes are sterile in health; but they are so liable to infection that they should be treated as infected in practically all cases. The mucous membranes of the stomach and duodenum in health are sterile, but all other mucous surfaces connected with the alimentary tract are to be treated as if infected.

Cutaneous and mucous surfaces are difficult to sterilize without inflicting such damage upon their epithelial covering as would diminish their powers of resistance to fresh infection from without. Mucous membranes in nearly all parts possess numerous glandular crypts into which organisms may penetrate, and from which it is impossible to dislodge them. Cutaneous surfaces have numerous glands and hair-follicles, and in addition are covered with a layer of dead epithelium of varying thickness, which prevents antiseptics from reaching the deeper layers to which organisms may have penetrated. It is agreed that these difficulties cannot be completely overcome, and that in consequence absolute sterilization of skin and of mucous membrane is impracticable.

Another source of infection which is beyond the control of the surgeon may be encountered when he operates upon tissues which have already become infected. His aim is then to limit, as far as may be, the dissemination of the existing infection, and at the same time to exclude all fresh sources of contamination. Infected tissues are less able to resist the attacks of fresh infective agents than are healthy tissues; mixed infection may therefore occur, the results of which may be disastrous. A well-known instance is seen in the serious consequences which may follow mixed infection of a tuberculous lesion.

So far as the operation-area is concerned, rigid asepsis is therefore an unattainable ideal towards which the surgeon may strive, and the nearer he approaches it the safer does his work become; yet he cannot expect to attain it completely. Fortunately it is not essential to success that he should. Tissues which normally contain bacteria heal without difficulty in the presence of the organisms to which they are accustomed.

All tissues have the power of dealing with a certain amount of outside infective matter brought into contact with them. The result is never in doubt if the dose of infective material is small and its virulence low, while the defensive mechanism of the tissues is not impaired by general ill-health or by direct injury before or during the operation. The capacity of different tissues to deal with infective material is not uniform ; the peritoneum possesses powers of defence against bacterial attack which are perhaps unequalled, and which consist partly in absorbing infective matter, and partly in isolating it by plastic inflammation. Mucous membranes and skin-surfaces are not germ-free in health, and probably possess greater powers of resistance than others which are normally sterile.

The *atmosphere* cannot be excluded nor can it be efficiently sterilized ; it is therefore dealt with merely on the general principles of ventilation. The atmosphere of a surgical ward in which suppurating cases are lying always contains a certain number of pyogenic cocci and other pathogenic bacteria, suspended in floating particles of moisture or of dust. Moisture evaporates and solid particles settle as dust, which is easily carried by currents of air from one resting-place to another. Tissues explored in such an atmosphere are in danger of infection. The general atmosphere of a hospital theatre and of all clean, well-ventilated, and uncrowded dwelling-houses is, however, free from pathogenic organisms, although not actually germ-free, and no harm need be feared from exposing healthy tissues to it. In the country the atmosphere contains fewer bacteria than in towns.

Surgical theatres are now so constructed as to be practically dust-free, but when operations are performed in private houses care must be taken that dust is either completely removed or else remains undisturbed until the operation is over. This matter will be referred to again in another connection.

Everything except the atmosphere which comes in contact with the operation-area must be sterilized. The immediate surroundings of the area are covered up with sterilized cloths—some waterproof, others not. Instruments and dressings are sterilized immediately before use. Under modern technique the surgeon is invisible, and is so far enveloped in sterilized garments that he is never in actual contact with his patient at all. He operates through a sterilized protective medium.

* * *

We have now to consider in more detail the sterilization of the skin, and of the surgical armamentarium.

Into past controversies upon the necessity of sterilization in surgical work, and upon the relative advantages of heat and chemical disinfectants, it is quite unnecessary to enter at the present day. The necessity of operating in bacteria-free surroundings has been universally conceded, and chemical disinfectants have been relegated to a subordinate place because, being not only germicides but also destroyers of cell-vitality, they damage the tissues they are intended to protect, and so reduce both their capacity of healing, and their ability to resist infection, should organisms obtain access to them in spite of precautions. In other words, *aseptic* methods are universally recognized as being preferable to *antiseptic* methods. Although the use of chemical antiseptics during operations upon healthy, *i.e.* non-infected tissues, has been abandoned, yet when infected tissues are being dealt with the case is obviously altered, and antiseptics may properly be employed, their use being limited to the infected area, as far as may be. In operating upon non-infected tissues the surgeon's aim is to bring nothing in contact with the operation-area that has not previously been rendered germ-free. This can be done by heat alone in the case of the whole of the surgeon's armamentarium ; the skin of the patient, the surgeon, and his assistants must, however, still be dealt with by chemical means, as heat is obviously inapplicable.

Sterilization of the Skin.—Numerous methods of sterilizing the skin have been advocated and practised in the past, but general surgical opinion has now practically eliminated all but three, viz. the iodine method, the alcohol method, and the alcohol and mercury method. The former, although a comparatively recent introduction, is very widely employed in all countries.

Iodine is a germicide of great potency, and a 2 per cent solution is reliable for surgical purposes. This solution stains the skin, but does not damage it. In an alcoholic solution it penetrates the epidermis more freely than in a watery solution ; water imbibed by the cells causes them to swell and to become impermeable, thus preventing the iodine from reaching the layers beneath. In this country tincture of iodine, which contains 2½ per cent of iodine, and the same quantity of iodide of potassium dissolved in 95 per cent alcohol, is usually employed. It should be applied to dry surfaces only, for the reason just mentioned.

American surgeons use a somewhat stronger solution than this ; tincture of iodine of the United States Pharmacopaeia contains 7 per cent of iodine, and this is used diluted with 30 to 50 per cent of alcohol, the dilution then containing 5 per cent to 3·5 per cent of iodine (Wesley Bovée).

Before using the iodine, hairy parts must be shaved, and the skin must be thoroughly cleansed with warm water and soap, or by rubbing the surface firmly with a swab soaked in turpentine, ether, or acetone. This effectively removes fat, without causing the epithelium to become swollen by imbibition, and thus resist permeation by the iodine subsequently; when the skin has thoroughly dried the iodine is applied.

Perchloride or biniodide of mercury are more suitable for sterilizing the skin than carbolic acid and the various coal-tar antiseptics, such as lysol and creolin, as they cause less irritation from frequent or prolonged use. In some individuals, however, the converse is the case. The penetrating power of the solution is greatly increased by the addition of alcohol, and Leedham Green has shown that the best results can be obtained by the use of a solution of 1 part to 1000 of the mercury salt in 75 per cent alcohol. Alcohol is itself an antiseptic of great potency, and some surgeons, following Ahlfeld, use absolute alcohol for sterilizing the hands and nothing else. Kocher uses 85 per cent alcohol for this purpose.

We can now consider in detail the method of sterilizing the *skin of the operation-area* and the *hands of the surgeon and his assistants.*

The Operation-Area.—Except in emergencies a preliminary hot bath of soap and water should always be given. In an abdominal operation the skin of the whole abdominal wall should be prepared, from the pubes to the xiphoid cartilage, together with the flanks and the groins. More than one incision may be required to complete an operation satisfactorily, and further, disease may be unexpectedly encountered in distant parts of the abdominal cavity. Shaving should include the upper part of the vulva as well as the suprapubic area; the umbilicus requires special care in cleansing, especially in corpulent women in whom a deep depression is always found. The clean skin may then be rubbed over with a swab soaked in acetone, turpentine, or ether to dissolve fatty material remaining in the ducts of the glands.

If the *iodine method* is employed the skin thus prepared is covered up with a piece of sterilized lint and a bandage until quite dry. Then tincture of iodine is freely applied with a boiled brush to the whole abdomen, or sprayed over it with an atomizer, special care being taken with the suprapubic and umbilical areas. The tincture must be freely applied until the skin is stained a deep brown colour. It dries rapidly, and the skin is then again covered up with a sterilized dressing which is not disturbed until the patient has been anaesthetized and the operation is about to commence, when the painting with iodine is repeated in exactly the same manner.

Iodine is, as a rule, well supported by the skin of the abdominal wall. Occasionally a transient erythematous or papular rash is produced, and in rare instances bullae or small areas of excoriation may be seen, but these difficulties are rare.

In an emergency operation in which there is no time for prolonged preparation, it is best to shave the abdomen dry, to attempt no cleansing with soap and water, but freely rub the skin with acetone and then apply the iodine to the dry shaved skin. For the reasons mentioned above, more effective penetration will be secured if the skin is not soaked before the iodine is applied.

If the mercury and alcohol method is employed the clean skin is rubbed firmly with a swab soaked in the solution (as above), and then a compress wrung out of a warm *watery* solution of 1 in 1000 perchloride or biniodide is laid over the abdomen and allowed to remain until the operation, or renewed if more than a few hours elapse. Time is essential to this method, and herein lies its chief disadvantage, for it is unreliable in an emergency. In other respects the practical results obtained with it have been scarcely inferior to those yielded by the iodine method.

In *vaginal operations* the preparation of the operation-area presents much greater difficulty than in the case of the abdominal wall. Complete sterilization is probably no more necessary here than elsewhere, but the bacteria present in health are more varied and numerous, while infective conditions in which pathogenic organisms may be expected are common. When the parts are healthy the vulva should be shaved, cleansed, dried, and covered with iodine solution, in much the same manner as already described. The vagina should be freely douched before operation, and, when under anaesthesia, first carefully dried and then swabbed with iodine. When purulent infective discharges are met with, as in gonorrhoea, sepsis, advanced malignant disease, or urinary and faecal fistulae, prolonged preliminary preparation is required before any surgical procedure can be undertaken. The success of plastic operation is gravely imperilled by infective conditions of the skin and mucous membranes, and vaginal coeliotomy is attended by considerable danger. This matter will be again referred to in the Article on Vaginal Coeliotomy.[1]

In many abdominal operations also, it is desirable to have the vulva and vagina fully prepared. Examination under anaesthesia immediately before commencing the operation is rendered safer; and further, the vaginal walls may be exposed, as in opening the posterior fornix for drainage. In all cases of panhysterectomy, where the vagina is deliberately to be laid open from above, the necessity of complete vaginal preparation is self-evident.

The Hands of the Surgeon and his Assistants.—Along with the hands the forearms up to the elbows should always be included. The difficulty of sterilizing these parts is even greater than in the case of the operation-area, and the almost universal use of sterilized rubber gloves to cover the hands is due to the recognition of this difficulty.

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[1] See page 614.

Further, and this is even more important, the surgeon must *at all times* endeavour to protect his hands from contact with infective wounds, tissues, or discharges. This he can do simply and effectively by using rubber gloves, not only when operating, but in all cases of possible infection, such as when making vaginal and rectal examinations, dressing wounds, or handling dead tissues. Hands infected with pathogenic organisms are obviously a source of great danger ; it is very difficult to render them safe for operative work, and the routine of sterilization described below must be repeated several times in such cases before an operation is undertaken. Kocher has insisted that the real value of rubber gloves lies in wearing them between operations, so that contamination with infective material can be absolutely avoided. They can then be dispensed with during the operation.

It must be clearly understood that the use of gloves does not dispense with the necessity of careful preliminary sterilization of the hands. Gloves may be pricked with a needle or torn during an operation ; their usefulness depends upon their being intact, otherwise the wound is not protected from the operator's hands nor are these protected from contamination by infected fluids or tissues.

The surgeon should at all times take care of his hands ; cuts and abrasions are possible points of entrance of septic organisms, and, in addition, the discomfort they cause in working disturbs and impedes the operator. The nails should be kept short and the cuticles trimmed ; the skin should not be roughened by the use of unduly strong antiseptic solutions, and should be kept supple by the daily use of cold cream or other oleaginous preparations.

In preparing for an operation the first and most important stage is to scrub the hands and forearms thoroughly with soap and running water *for ten minutes.* This stage removes dirt, dead epithelium, and fatty material from the mouths of the glands and hair-follicles ; care should be taken that the interdigital spaces, the folds on the flexor surface of the wrist, and the ulnar surfaces of the hands and wrists are not cursorily dealt with, as is very often done by an inexperienced assistant. After the soap has been washed off, the hands and forearms are firmly rubbed over with a swab soaked in the alcohol-mercury solution ; if a watery solution is used the whole hand and forearm should be immersed, and kept immersed for at least two minutes to allow the solution to penetrate. For this purpose deep wide jars or baths are required holding several pints of the solution (Fig. 66).

As has been said, the great majority of surgeons cover the hands thus prepared with sterilized rubber gloves. One advantage of the use of rubber gloves is universally conceded, viz. that they completely protect the hands of the surgeon from contamination in dealing with a septic case, and thus enable him to continue his work without fear of carrying infection to the next case. Their use under such circumstances is imperative. In abdominal work it is, further, well recognized that a septic focus may be encountered, or an infected cavity laid open quite unexpectedly, and in this fact lies a powerful argument for the routine use of gloves.

One disadvantage undoubtedly attends them, viz. a certain amount of loss of delicacy of tactile sensation; although this can be largely regained by persistent usage it is probably never entirely made up. Rubber gloves can, however, be made very thin, and in abdominal work this loss of sensation is hardly realized, except in dealing with soft structures such as the wall of the small intestine, so long as all manipulations are conducted under sight. But in manipulating structures which cannot be seen it may be a source of real danger; lines of cleavage may be missed, and an excessive amount of force unconsciously employed in separating adhesions.

On account of these disadvantages a few surgeons dispense with gloves altogether, and others although usually employing them, discard them at moments of difficulty, such as have been referred to.

Kocher has advocated the use of sterilized cotton or thread gloves. These, he says, act as filters, in the meshes of which skin-organisms become entangled so that although many are found on the inner surface very few come through to the outside. They must, however, be changed frequently during an operation. Their only advantage over rubber gloves is their cheapness, and it cannot be denied that they afford only imperfect protection. They are employed by Kocher in handling ligatures which he rightly says should never be allowed to touch the unprotected skin, lest cutaneous organisms may become entangled in the ligature and implanted in the tissues.

The rubber gloves may be sterilized by boiling or by dry heat. Kocher says they must be boiled for *six and a half hours*; ten to twenty minutes is usually considered enough.

Gloves which have been boiled must be put on the hands wet, and if the glove is filled with sterile water, or with weak mercurial solution, it can be drawn on with ease. The deep jars used for the antiseptic hand and forearm bath are also very convenient for putting on gloves (Figs. 66 and 67). The disadvantage of the wet method is that the hands of the surgeon suffer to a considerable extent, the skin becoming sodden and losing some of its tactile sensibility during a prolonged operation.

When the dry method is used, the gloves are first powdered both inside and outside with French chalk and then placed with the instruments in the Poupinel, or with the dressings in the autoclave (*vide infra*). With each pair of gloves a small gauze swab and a packet of French chalk is placed in the sterilizer. After the sterilization of the hands has been carried out as described above, the skin is carefully dried with

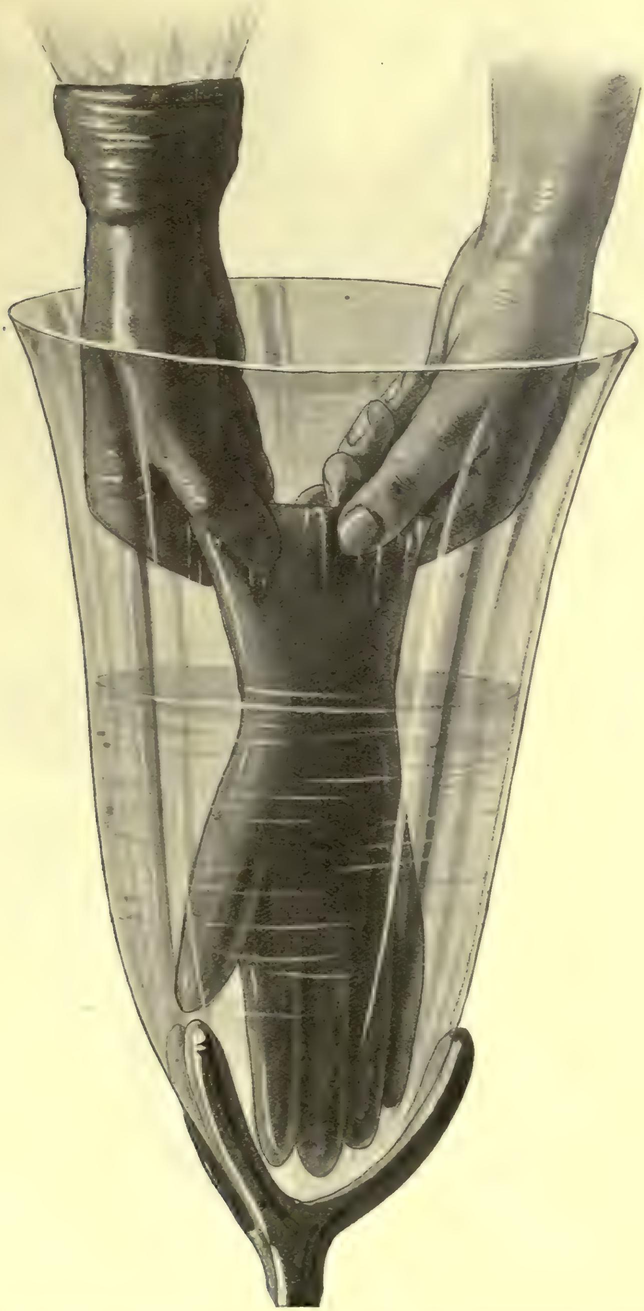


FIG. 66.—The antiseptic arm-bath. Filling the glove with the solution.

a sterilized towel, and then powdered freely with chalk from the sterilized packet.

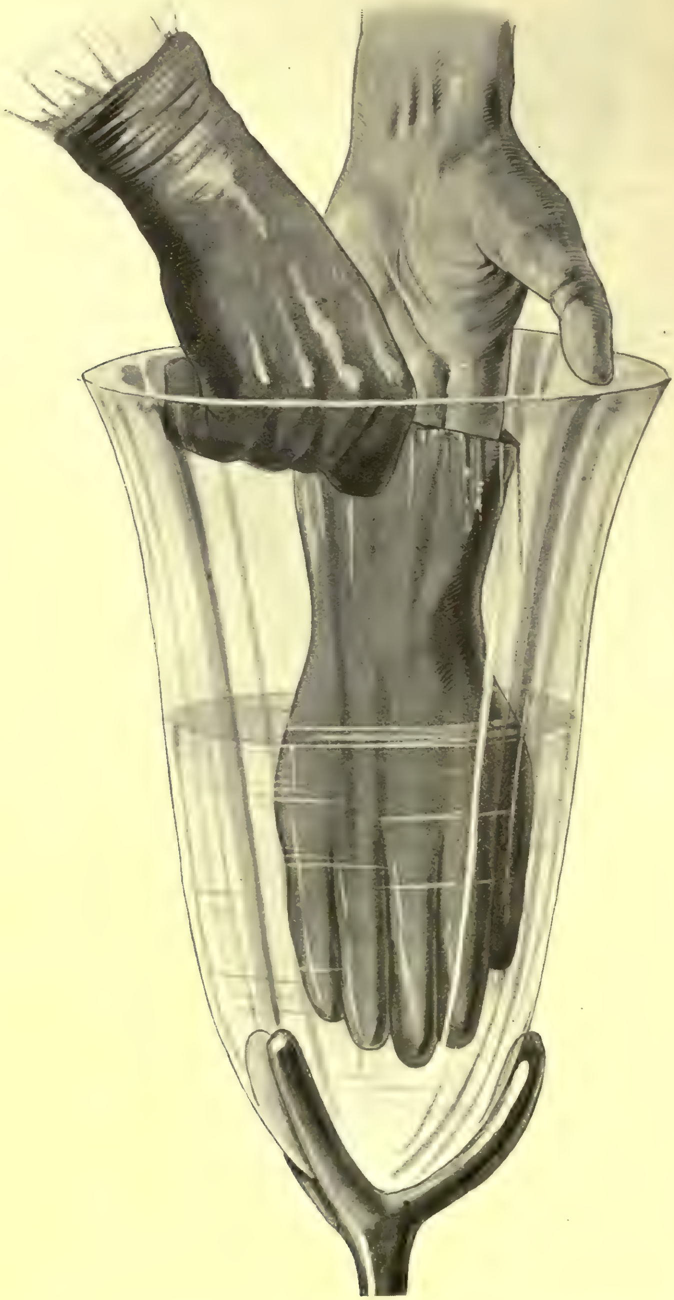


Fig. 67.—Drawing on the glove when filled.

In putting on the gloves contact of the fingers with the outside of the glove should if possible be avoided. The wrist of the glove is held with the sterilized

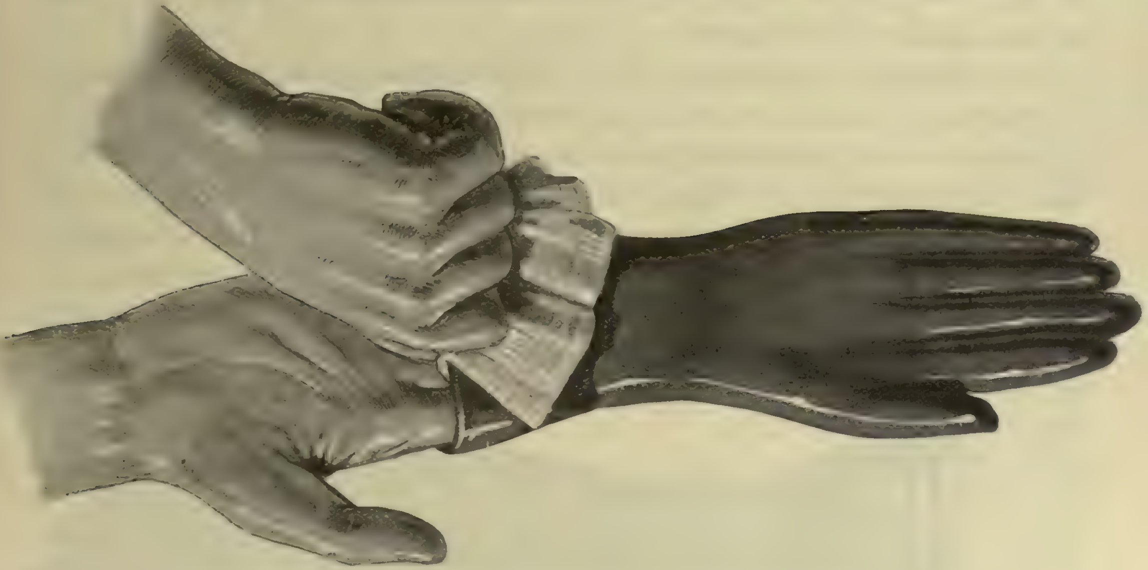


Fig. 68.—Drawing on the glove with the aid of a sterilized swab.

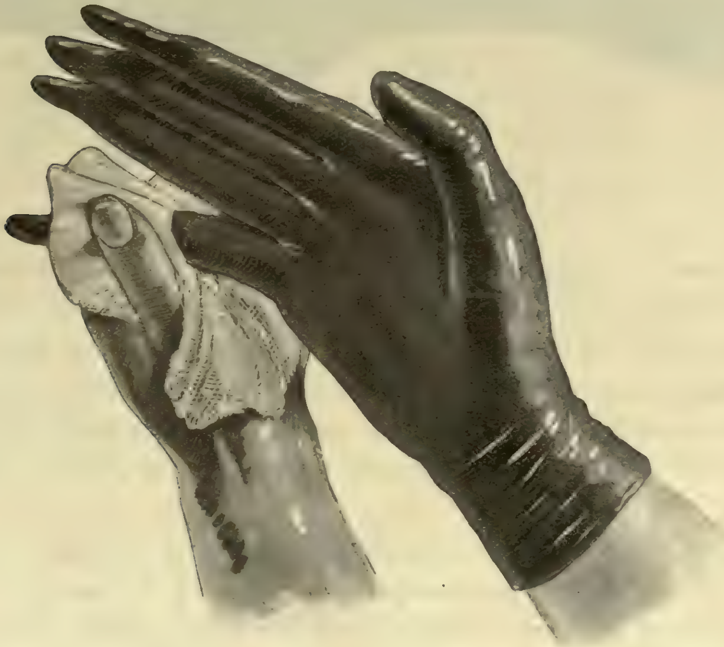


Fig. 69.—Rubbing on the sterilized glove.

swab, and the hand slipped as far as possible into it (Fig. 68). Then the other glove is put on as far as possible in the same way. The swab can then be used to rub the gloves over the fingers, and finally the wrist is drawn over the sleeves of the sterilized gown (Figs. 69 and 70).

Sterilization of Instruments.—The simplest method of sterilizing instruments is to boil them immediately before use. They must be completely immersed, as the temperature of the steam rising from the surface of boiling water is considerably below the boiling point. The instruments must be boiled for a *minimum* of ten minutes. The addition of a teaspoonful of soda or of borax to the water in the kettle raises the boiling point to 104° C., and diminishes the risk of rusting. It must be understood that perfunctory boiling of instruments is useless. Instruments dropped during an operation and again required, must be first *cleaned* and then *re-boiled for at least ten minutes.* Rubber gloves and drainage tubes may be freely boiled without suffering any harm.

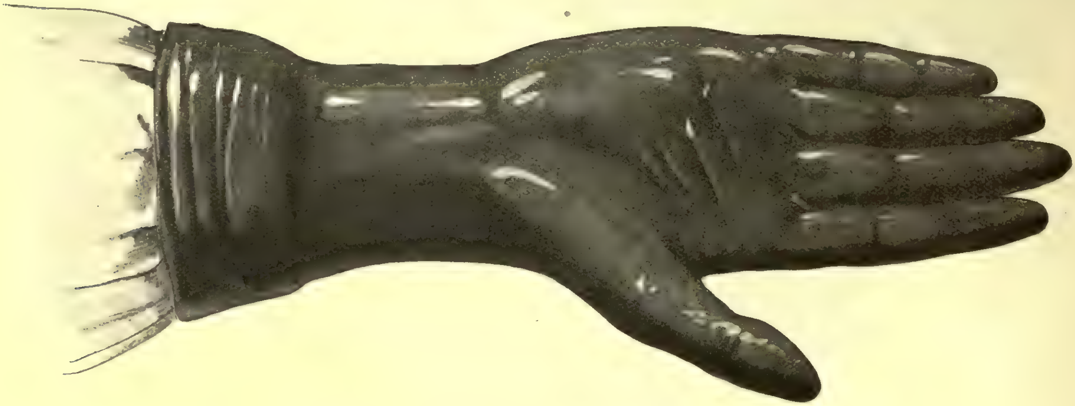


Fig. 70.—Rubber glove brought over the sleeve.

The disadvantages of boiling are that sharp instruments lose their edge, and that nickel-plating wears off with considerable rapidity. Most surgeons who employ boiling are consequently content to sterilize knives, scissors, and needles by immersion in alcohol, or in 1 in 20 carbolic acid lotion for half an hour before using them.

The alternative to boiling is to sterilize instruments by dry heat. This necessitates their exposure to dry air at a temperature of 140° C. for an hour in a special apparatus. While it preserves them from injury this method has certain disadvantages. A large supply of instruments must be in use, sufficient to carry the operator through all the operations he contemplates doing at the sitting. Re-sterilization while work is going on is obviously impracticable. For emergencies the surgeon must still fall back upon the method of boiling, which is rapid and can be carried out with simple domestic appliances.

The apparatus commonly used for the dry method is the Poupinel Sterilizer. This consists of a metal box with double walls, the hot air being made to circulate around the central space in which the instruments are laid out on trays. Gas may be employed as the source of heat, the burners being placed beneath the floor of the sterilizer. In about a quarter of an hour a temperature of 140° to 150° C. can be attained in the central chamber, and by a mechanical regulator the gas flame can be adjusted to maintain this degree of heat. A thermometer indicates the temperature of the air in the outer space, which is about 10° higher than that in the centre. Exposure to a temperature of 140° C. for an hour is required for efficient sterilization. After the sterilizer has cooled down the trays are removed and covered with a sterilized cloth.

Sterilization of Surgical Fabrics.—Under the term ‘ fabrics ’ may be included gowns, veils, towels, waterproof coverings, swabs, pads, rolls of gauze, ordinary surgical dressings, and bandages. These are all to be sterilized by steam under high pressure. The apparatus in common use for this purpose is the *autoclave*, in which a pressure of from 10 to 20 pounds can be obtained, sufficient to cause the steam to permeate thoroughly all parts of the materials subjected to its action (Fig. 71). At this pressure the steam reaches a temperature of 120° to 125° C. In hospitals the apparatus is worked from the steam boiler, and large quantities of material can be prepared each time, thirty minutes' exposure to the steam being required. A collection of materials sufficient for a single operation is put up in a metal box, to be sterilized in the autoclave. The apparatus is furnished with means of producing a vacuum by which the steam which has permeated the fabrics is withdrawn, and they are thus dried. When cool the box is taken out and hermetically sealed by soldering the lid. It may then be kept for any length of time before being used. Dressings sterilized in this way, which can be relied upon and are in general use, are obtainable from surgical instrument makers of repute. This enables the surgeon to have ready, always at his command, boxes of sterilized materials arranged to meet the requirements of any operation which he may have to perform ; for gynaecological work, separate boxes for abdominal and for vaginal operations may thus be arranged.

In hospital work ‘ drums ’ are commonly used. These are metal boxes the sides of which are perforated and fitted with a slide which allows the perforations to be opened and shut without raising the lid. The drum is packed and placed in the sterilizer with the perforations open ; through them the steam is driven by pressure into the contents and permeates them. After half an hour's steaming the drum is removed and the slide shut down. Drums are not quite air-tight and if not used within twenty-four hours they must be re-sterilized.

The working of the autoclave should be tested from time to time by the engineer to see that the requisite pressure is obtained ; otherwise efficient permeation of close fabrics, such as towels and aprons, will not occur, and portions will remain unaffected by the steam. Bacteriological tests should also be applied. This can be readily done by enclosing a parcel of infected swabs in the box of dressings before sterilization ; afterwards they are sent to the laboratory for cultures, which should prove negative if sterilization has been efficient.

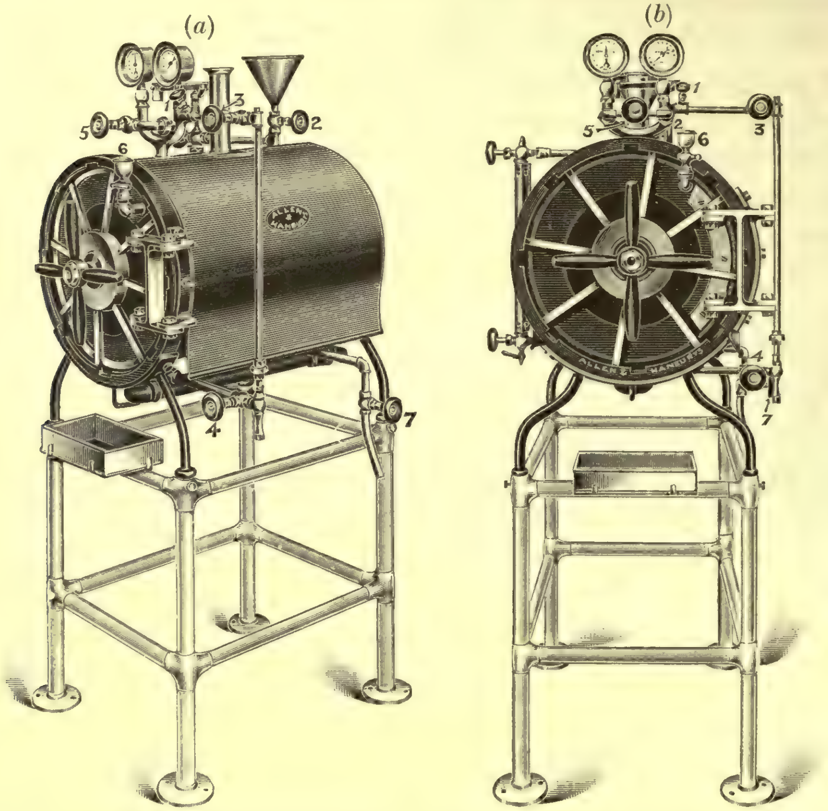


Fig. 71.—High-pressure steam sterilizer—(*a*) side view ; (*b*) front view. (Autoclave.)

1. Air vent.
2. Water valve to jacket.
3. Vacuum-pump valve.
4. Valve connecting chamber with vacuum-pump.
5. Steam valve to chamber.
6. Valve to disperse vacuum.
7. To drain water-jacket.

The practice of using marine sponges instead of swabs, or along with swabs, has been almost universally abandoned on account of the extreme difficulty of cleansing them after use. Artificial sponges made of gauze alone, of cotton wool enveloped in gauze, or of Gamgee tissue, are preferred ; these are used only once and are discarded as soon as they become soiled. In some cliniques they are boiled in a solution of soda, dried, and then re-sterilized, but the cost of the material is so small that the usual practice is to use them only once.

During an abdominal operation sterilized swabs are required for two purposes : (*a*) to absorb blood and other fluids and keep the field of operation clear, (*b*) to isolate the operation-area from the rest of the abdominal cavity. For the first purpose flat swabs from three to four inches square are most convenient ; these should be used for swabbing only, and should never be put into the peritoneal cavity ; they must be carefully counted before the operation, and again at the end, by a responsible person, in order that none are overlooked. For the second purpose large sheets or long rolls of gauze are most convenient ; these should be soaked in warm, sterile, saline solution before being used, as dry material in bulk absorbs moisture freely from the peritoneal surfaces with which it is in contact, and thus does them a certain injury. To sheets used in packing, a piece of tape should be sewn which can be left hanging out of the wound and then clipped to the sterilized body coverings ; the ends of gauze-rolls can be similarly dealt with, and thus the risk of overlooking them before closing the wound is avoided.

It must be recognized that the surgeon is personally responsible for the proper precautions being carried out against leaving swabs or instruments in the abdomen. He cannot always count them himself, but he must see that this is done by a responsible person. This accident may entail the most serious consequences, and being clearly preventible by the exercise of reasonable care, the surgeon cannot disclaim the grave responsibility.

Ligatures and Sutures, and their Sterilization.—*Ligatures* are required for tying divided vessels, or sometimes small masses of tissue which contain vessels ; *sutures* are required for re-uniting cut surfaces or planes of tissue.

Ligatures must be composed of material sufficiently strong to resist the blood-pressure on the walls of the vessel they enclose until thrombosis finally seals it up ; in the case of vessels of small size the material used must therefore be able to resist absorption by the tissues for three or four days. At the end of that time their work is done ; if the material used is catgut, leucocytic absorption disposes of it completely so that it disappears leaving no trace. This will, however, only occur in the absence of infection ; when suppuration is present, leucocytic absorption is suspended, and the catgut remains unaltered. Sterile catgut is the ideal ligature for an aseptic operation, and its use is almost universal. But when large arteries, such as the internal iliac, are ligated, an unabsorbable ligature is usually preferred, as obliteration by thrombosis is necessarily much slower.

Sutures must be composed of material which is either unabsorbable by the tissues, or which will resist their disintegrating action for a definite and sufficient time. Sutures employed to re-unite the layers of the abdominal wall must be sufficiently strong to resist a considerable degree of tension, for in the acts of coughing and vomiting a good deal of strain is necessarily put upon them ; this may be still further increased by abnormal abdominal distension. They must therefore be both strong and enduring, so that the planes of tissue may be held firmly together until the process of repair is complete. Specially hardened catgut is used by most surgeons for this purpose.

By special preparation, the toughness of catgut can be so increased as to enable it to endure, while buried in the tissues, for two or three weeks, being in the end completely absorbed. Sutures which by their situation may be subjected to the action of the digestive juices, *e.g.* those placed in the wall of the intestine or stomach, are more likely to disintegrate rapidly than others. In such situations unabsorbable material is usually employed, and some surgeons prefer to use an unabsorbable material for all their sutures. Silk and linen thread are the two materials of this kind in common use. They possess one decided advantage over catgut in that they can be readily sterilized by boiling. Bulk for bulk they are both much stronger than catgut, and thinner sutures can accordingly be made use of.

Unabsorbable stitches, when sterile, may remain buried in the tissues in perpetuity without giving rise to local irritation. In pelvic operations, however, the situation of the buried stitches inevitably exposes them to a certain risk of direct infection either from the bowel or from the genital tract ; in addition the possibility of haematogenous infection attacking a buried foreign body cannot be altogether excluded. Consequently it is found that buried silk sutures occasionally give rise to local suppuration after a long period of time has elapsed. In comparing hardened catgut with silk or thread it must be recollected that the sole advantage of catgut is its absorbability, and whenever this quality is lost the special value of the material is at the same time diminished.

Thread impregnated with celloidin was introduced by Pagenstecher. One of the objections to the use of thread and silk as buried sutures is that if bacteria are present in the tissues they may be carried into the interstices of the suture as it bcomes impregnated with the tissue-fluids. Here they may remain, preserving their vitality, and constituting foci of possible infection. Impregnation of the suture-material with celloidin fills up the interstices with an insoluble material and renders it completely non-absorbent.

Occasionally sutures are required to resist an extreme degree of tension, as in the approximation of widely separated skin-edges after amputation of the breast, or of widely separated aponeurotic edges in ventral hernia. A stout, unabsorbable, organic material suitable for this purpose is silkworm-gut or kangaroo-tendon ; silver wire, or phosphor-bronze wire are the most suitable metallic sutures, the latter being very inexpensive and obtainable commercially in convenient sizes.

A fine suture of proportionately high resistance is *horse-hair.* This material is very convenient for coaptation stitches in positions where oedema is likely to arise, and where the skin is unusually well supplied with sensory nerves. In plastic operations on the vulva and urethra, interrupted horse-hair stitches occasion less discomfort than anything else. Their black colour also makes their removal easier ; black thread is the best substitute for horse-hair.

Sterilization of Ligatures and Sutures.—Silk, thread, silkworm-gut, horse-hair, and the various metal sutures are all sterilized by boiling. Silk and thread, consisting of closely-twisted, permeable strands, require at least an hour's boiling on two occasions ; impermeable material, such as silkworm-gut and metals, does not require so long. After being boiled, the suture-material may be kept immersed in alcohol or in 1 in 20 carbolic lotion until required. It is, however, best to reboil it immediately before use. Kocher advises that silk should be prepared by first boiling it in ether for twelve hours to remove grease, and then boiling it for fifteen minutes in a 1 in 1000 solution of perchloride of mercury, by which means the material becomes impregnated with the antiseptic.

Catgut is by no means easy to sterilize, and great care is requisite in the preparation of the raw material from the intestine. Sheep's gut is the best, and the preliminary cleansing which forms the first stage in the process of manufacture is very important. If this stage is inadequately carried out, organisms which are not dead may be locked up in the substance of the material, and when the suture dissolves in the body-fluids, may be set free and multiply, causing local infection, or if their virulence is high, possibly general septicaemia. Very great care is therefore called for in the sterilization of raw catgut, so that the substance of the material as well as its surface are adequately treated.

Unless its natural toughness is increased by artificial means, catgut becomes completely softened in two or three days when buried in the tissues. It is therefore too weak to use in situations such as the abdominal wall, unless specially hardened either before or during the process of sterilization. Bichromate of potash and formalin have both been largely used as hardening agents. The former is used in dilute solution (1 in 1000), and allowed to act upon the gut for about an hour, after which the excess is washed away and the gut dried before being sterilized. Catgut of medium thickness, so prepared, will resist absorption for about twenty days. To increase the resistance a stronger solution of bichromate should be used.

Formalin has a similar but less marked action, and is used in 5 per cent solution, from twelve to twenty-four hours' immersion being employed. Formalin, however, does not permeate the gut, but only acts upon its surface ; it cannot therefore be regarded as a sterilizing agent, for bacteria buried in the material are unaffected. For the same reason catgut hardened in formalin cannot subsequently be properly sterilized. It must therefore be sterilized first by the iodine method, and hardened subsequently as the last stage of the preparation.

Whether artificially hardened, or not, the sterilization of catgut is a matter of great difficulty. It cannot be boiled in water or steamed, without being at the same time completely spoiled by swelling and softening, but it can be sterilized in dry air at a temperature of 140° C. In oily media or in alcohol, it can be boiled without damage, and use is largely made of this method. The alcohol-method was introduced by Répin, who placed a strand of catgut in a thin glass tube, sealed this in the flame, and then placed it in the autoclave at a temperature of 120° C. Absolute alcohol boils at a temperature of about 45° C., therefore in the autoclave the catgut is subjected to the vapour of alcohol under considerable pressure. When the tube cools the vapour condenses and the sterilized gut may be preserved in the fluid-medium for any length of time. The tube may be repeatedly sterilized in this way, if desired. Catgut thus prepared is hard and somewhat brittle (non-pliable), difficult to tie securely in knots, and clumsy to work with.

The best-known method of sterilizing catgut in oil is the cumol-method introduced by Krönig. Cumol is a coal-tar product (trimethylbenzine) which boils at a temperature of 165° C. The strands of catgut must first be carefully cleaned, and *completely dried* before being placed in the cumol. The oil is heated in a sand-bath to 165° C., and the catgut boiled in it for two hours. The vapour of cumol is inflammable, and care is therefore required in the preparation. The cumol is then decanted, and the excess evaporated by leaving the strands of gut in the sand-bath while it cools. They are then kept in sterilized stoppered glass tubes till required.

During recent years catgut sterilized in iodine has been freely employed. Iodine is a powerful antiseptic and a 1 per cent solution will destroy staphylococci in a few hours. Prolonged contact with a watery solution softens the gut, while in alcoholic solution it may be kept for several months without deteriorating.

Strands of clean catgut may be wound on spools and immersed in a watery iodine solution containing 1 per cent of iodine and 1 per cent of iodide of potassium ; in this they are allowed to remain for a week, and are then transferred to a spirituous solution of ½ per cent iodine in 50 per cent spirit in which they can be kept almost indefinitely.

The iodine method is simple and from the point of view of sterilization is reliable. To the tissues, however, iodine is an irritant, and the excess must be carefully washed away in fresh methylated spirit before the gut is used. Even then a certain amount is absorbed from the impregnated strand, as it becomes softened in the tissues ; stitches buried in the abdominal wall are therefore liable to set up local irritation, giving rise to accumulations of serous fluid, or to thickening and tenderness in the deeper layers of the wound.

The difficulties of preparing small quantities of catgut for use, and of keeping it when prepared are so great that many surgeons prefer to rely upon wholesale methods of preparation. Catgut sterilized by the alcohol-method of Répin, and supplied in sealed glass tubes of assorted sizes, can be everywhere obtained.

Catgut which has been sterilized by dry heat and subsequently kept in sealed packets offers certain definite advantages. The gut is much easier to work with dry than wet ; it can be held more firmly in the fingers, and tied more securely in knots. A formalin-iodine gut, sterilized by heat as the last stage of the process of preparation, is very satisfactory. The gut is reliably aseptic, strong, pliable, and will resist absorption for a reasonably long period, proportionately to the size of the strand. The most useful sizes are No. 0 for small vessels and No. 2 and No. 4 for other purposes. Absorption occurs more quickly in mucous membrane than in other tissues, and for vaginal plastic work No. 4 is more suitable than No. 2. As an alternative chromic catgut may be used for mucous membranes. Manufacturers of catgut usually assert that their material will resist absorption in the tissues for a certain definite number of days, varying from fourteen to forty. Opportunities of re-opening wounds show, however, that long before the suture disappears it becomes so much softened as to have lost practically all its retaining power.

As catgut is not suitable for all the purposes of a surgical ligature, other materials are to be kept at hand. In suturing intestine the effect of the digestive juices upon the suture-material must be borne in mind ; catgut is rapidly affected by them, and unabsorbable sutures are therefore preferred by most surgeons for such purposes. A few surgeons reject catgut altogether, and use silk or linen thread for all purposes. They hold that an unabsorbable stitch when sterile can do no harm by remaining buried in the tissues ; silk and thread can be easily and surely sterilized by boiling while the sterilization of catgut is a long and complicated proceeding. They prefer an unabsorbable stitch which is certainly sterile, to an absorbable one which is doubtful. They further point out that in infected tissues catgut ligatures are not dissolved or absorbed ; they persist as foreign bodies, just as do thread or silk stitches, and may thus keep up irritation and infection.

Linen thread has advantages over silk, in being cheaper, stronger, and more pliable. It can therefore be used in smaller sizes than silk, thus reducing the bulk of the stitch, a point of considerable importance in the case of buried sutures; its greater pliability renders it easier to tie securely, and in the case of a running stitch it causes less tension. Repeated boiling does not affect the strength of linen thread at all.

Metal sutures may be required in cases of amputation of the breast, where a large amount of skin has been removed, in order to approximate widely separated edges. Phosphor-bronze wire is much stronger and cheaper than silver wire, and is therefore to be preferred. In operations for ventral hernia, when the fascial and muscular layers are atrophied, filigrees of silver wire may be buried in the abdominal wall.

The Operating Room

Major operations, *i.e.* those which involve opening the peritoneal cavity, should only be performed in a properly arranged surgical theatre, unless the circumstances render this impracticable. Conditions of great urgency, such as profuse bleeding from a ruptured ectopic pregnancy, or an acute abdominal infection, must be operated upon wherever the patient may be, in order to avoid the serious risks of transport and of delay. In less urgent conditions the interests of the patient are best served by insisting upon her removal to a hospital or private nursing institution. In a private house the complex details of an aseptic operation of major rank can seldom be carried out with the minute accuracy which is desirable. The surgeon may be obliged to be content with arrangements which he knows are imperfect, and therefore do not afford that complete protection against infection at which he aims. This needlessly increases the operative risks, and should therefore be discouraged. In this country the public, and to some extent the medical profession also, are not alive to the fact that imperfectly-organized operations in private houses are necessarily attended by greater danger than the same operations performed in organized, surgical surroundings. Surgeons too readily yield to the wish of the patient to remain in her own home, supported as it usually is by the family doctor. The responsibility and anxiety of the surgeon are thereby greatly increased, and the surgical risks are enhanced without any compensating advantage being reaped by the patient, for experience shows that the most nervous women face the operative ordeal better when removed from their home surroundings. The routine to which the patient is subjected in an institution, and the absence of fuss or flurry from the environment, exert a tranquillizing influence which is of real value. A specially equipped operating room, although an important advantage, is therefore by no means the only one.

Into the construction of a surgical theatre it is impossible to enter in this article. Certain requirements may, however, be stated in general terms, and it is the duty of the surgeon to see that these requirements are adequately met in the theatres he makes use of. The first requirement is *light*; window-space must be large, and so placed as to avoid direct sunlight on account of the heat and glare which accompany it. Abundant artificial illumination must also be provided; part of this artificial light must be capable of direct reflection into the field of operation, so that the depths of a pelvic dissection may be sufficiently illuminated. The indirect method of illumination by reflecting a strong beam of artificial light by mirrors upon the operation field, introduced by Krönig, is superior to all others. The light is steady, soft, and uniform, and is entirely unaccompanied by heat, the arc lamps being placed outside the theatre, and the beam passed in through a specially constructed aperture. Small reflecting lamps, either portable, or fixed upon jointed stands, or in some cases head-lamps, are required in the absence of special apparatus.

The *atmosphere* of the theatre must be free from dust; this is ensured by reducing to a minimum shelf-surfaces, grooves, or angles upon which dust might lodge. Walls and floors must be made of impermeable material into which fluids cannot penetrate, otherwise pent-up infective matters may become set free from time to time as the result of desiccation and surface-friction. The air must also be suitably warmed and renewed by ventilation so as to be kept fresh. Many attempts have been made to filter the air entering a surgical theatre, not with the object of removing bacteria, but to free it from particles of dust which may be carriers of organisms. It is, however, very difficult, and is probably unnecessary in a fairly open locality. Indoor dust, contaminated as it is with organic particles, is more dangerous than outdoor dust, which seldom carries living active bacteria. Walls, floor-fixtures, and furniture must therefore be so constructed as not to favour the collection of dust, and to allow of its complete removal by simple methods of cleansing.

The furnishings of a theatre should be constructed of glass, iron, or earthenware, and should be movable as far as possible. An adequate supply of *boiled water* is an absolute necessity; in buildings furnished with a steam-supply, a small boiler may be provided for the theatre. Cold boiled water may be stored in covered receptacles, while the hot-water boiler is kept in use whenever the theatre is working. The *temperature* of the operating room should be equable and not too high ; 70° to 75° F. is quite sufficient if the operating table is furnished with heaters so that the patient's body may be protected from undue loss of heat (see p. 318). The air of a theatre is always moist, and if the temperature is allowed to rise too high, the sudden change when the patient is removed after the operation, greatly increases the risk of respiratory troubles, such as bronchitis or broncho-pneumonia, always inseparable from prolonged anaesthesia by inhalation. Undue cooling of exposed organs during the operation can be prevented by protecting them with warm sterilized cloths.

When a *private room* has to be prepared for a major operation, the main object of preparation is to remove all possible sources of atmospheric contamination ; while the other sources of danger are under control, the atmosphere is not. All collections of dust must therefore be cleared out, for movement in the room sets the particles in motion, and gives them the chance of being carried by air-currents into the field of operation. Carpets, window-hangings, tapestries, and curtains are to be taken up and removed ; pictures and other objects hanging on walls must be taken down ; every article of furniture not required for the operation should be removed to provide floor-space and increase the atmospheric capacity of the room ; then the floor and the walls are to be thoroughly scrubbed or cleansed with soap and water. All this should, if possible, be done twenty-four hours before the room is required for use, and it is then shut up until the time fixed for the operation. If time is not available for these preparations the carpet and all large pieces of furniture which cannot be removed should be completely covered up with damp sheets in order that the dust they contain may be laid and prevented from circulating in the atmosphere. In large towns sets of operating furniture, including an operating table, instrument-tables, bowls, and trays can be hired, and are of course preferable to domestic substitutes which the surgeon may at times be compelled to make use of. Metal bowls and trays can be sterilized immediately before use by flaming a teaspoonful of methylated spirit in each. Any tables made use of should be covered with clean sheets. The room must be suitably warmed and ventilated during the operation, and the importance of good natural light must not be overlooked. For direct illumination of the wound the surgeon must rely upon a head-lamp, or upon portable reflecting lamps held by assistants.

The Operation

We now approach the consideration of the actual performance of the operation, the *preliminary* preparations having occupied us hitherto. Certain other preparatory measures which we may call the *immediate* preparations, and which are to be regarded as an integral part of the operation, come next to be considered. They comprise the personal preparation of the operator and his assistants, and the isolation of the field of operation which has been already prepared by sterilization. As far as possible these matters should be reduced to a routine which can be followed by all persons concerned, and which is as simple as may be consistent with efficiency. The subject of anaesthesia is considered in this work in a special article (p. 369). Although choice of an anaesthetic in each case is a matter for the surgeon to decide, it is to the advantage of both the patient and the operator that its administration should be confided to specially trained men.

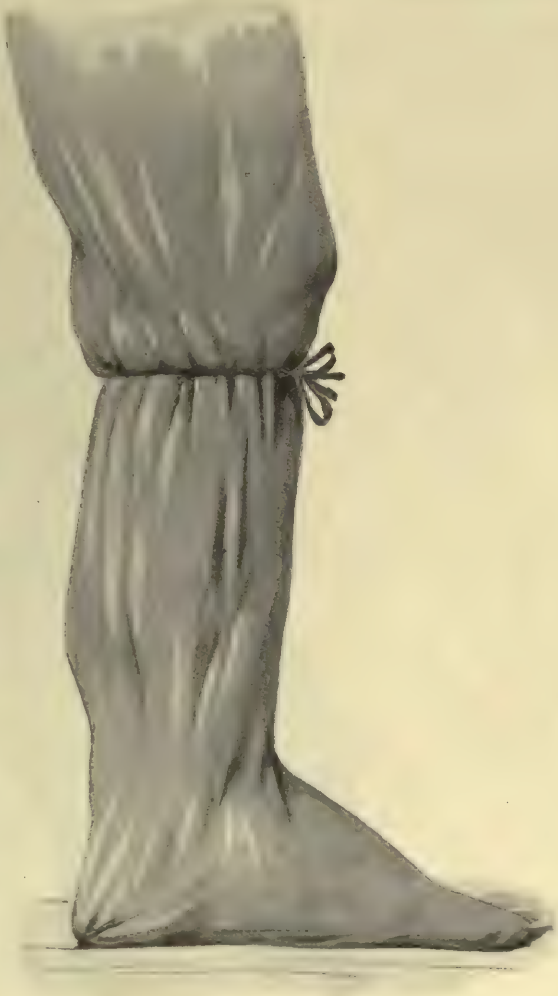


FIG. 72.—Leg-covering of waterproof tissue.

The Operator and his Assistants.—The operator should discard his outer clothing; linen trousers and a long apron made of thin mackintosh are then put on. The writer's custom is also to use loose leg-coverings of batiste-cloth which can be drawn on over the boots and tied below the knee (Fig. 72). In this attire the temperature of the operating room can be supported for several hours without discomfort. Further, the outer clothing is necessarily a carrier of bacteria, and to remove or cover it up before entering the operating room is a wise precaution. Nurses are dressed for operation in fresh clean dresses of washable material, over which a sterilized blouse or overall is worn.

The *disinfection of the hands* is the next step, and the same routine should be followed by the operator and each assistant who is concerned directly or indirectly in the operation. Sleeves are rolled up above the elbows, and the hands and forearms scrubbed attentively for ten minutes with spirit-soap, hot running water, and a freshly-boiled nail-brush, taken for the purpose out of a dish in which it has been immersed in 1 in 4000 mercurial solution. Then the soap is washed off in fresh water, preferably sterilized, although if running water is used this is not absolutely necessary. The hands and forearms are then immersed in a solution of 1 in 4000 mercuric chloride for two minutes, or rubbed firmly with a swab soaked in an alcoholic solution

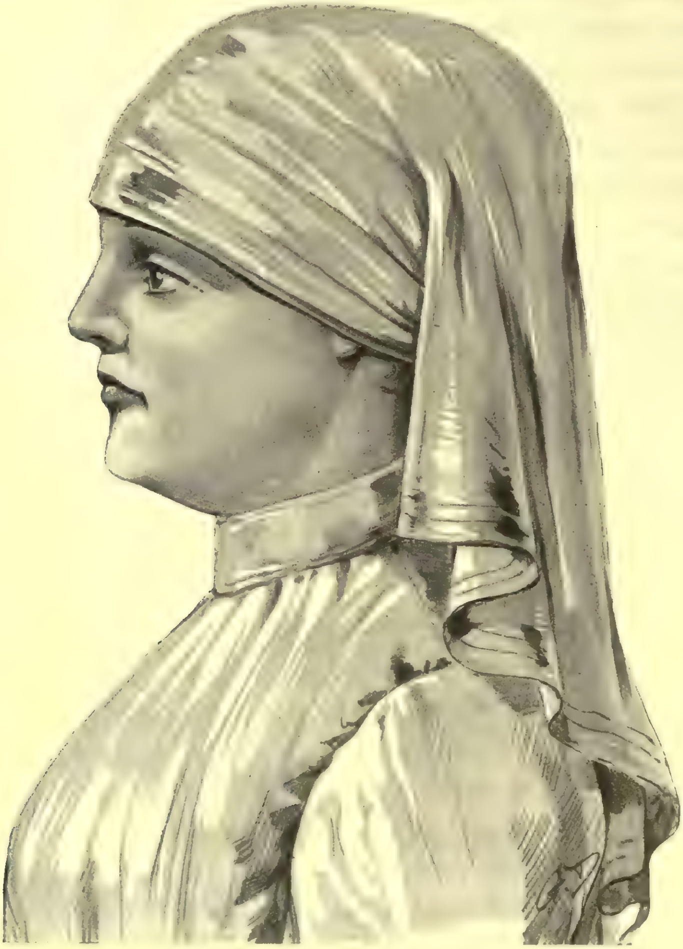


Fig. 73.—The head-covering for nurses.

of the same antiseptic (*vide supra*). Then a sterilized gown with long sleeves reaching to the wrists is put on, and a veil, or a cap and mask adjusted (Figs. 74, 75, and 76). Finally, the rubber gloves are put on with the precautions detailed on a previous page, and drawn over the ends of the sleeves. The only part of the body which is now exposed is the region of the eyes; the operator works through a sterilized screen which keeps him from direct contact with his patient.

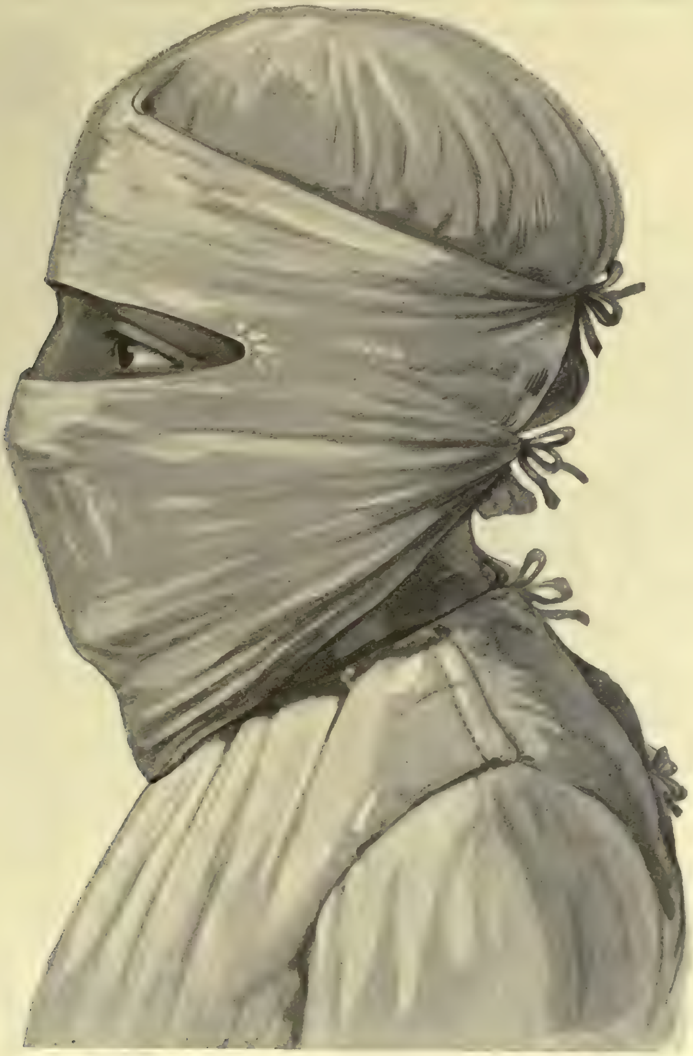


Fig. 74.—The operator's mask and head-covering.

The necessity of a covering for the hair is universally conceded, for from it solid particles of dust can be readily detached, but it is not the practice of all surgeons to cover the nose and mouth. Flügge first demonstrated the importance of mouth-coverings when he showed that in talking, minute particles of moisture, laden with mouth-organisms, are projected into the atmosphere. They may circulate in the atmosphere of the theatre and settle upon exposed surfaces, so that culture-plates, set at a distance of some yards from the speaker, may show abundant colonies of growth. Coughing and sneezing are of course more powerful disseminators of germs than talking. The object of the veil or mask is to prevent this. The writer's custom is to use a linen mask as a rule; this material does not entirely prevent the escape of moisture-particles into the air in coughing or sneezing, and if the operator is

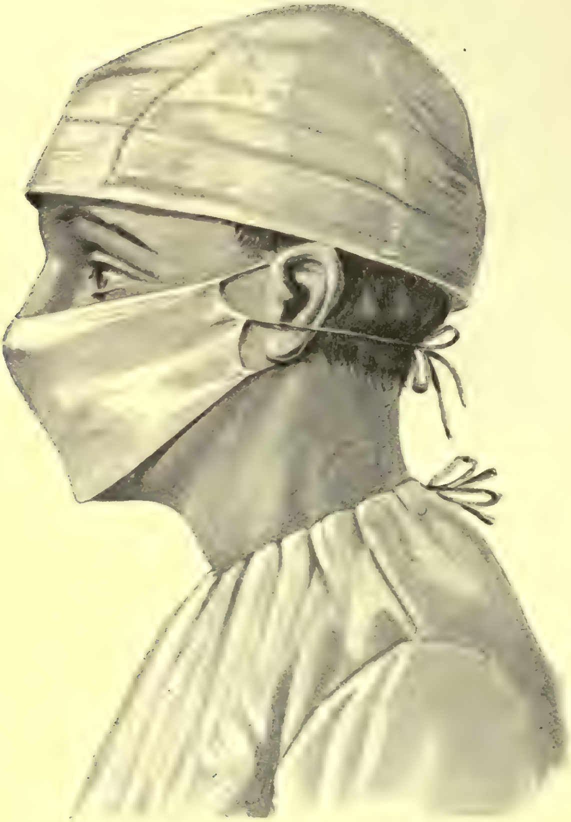


Fig. 75.—Another form of mask and head-covering.

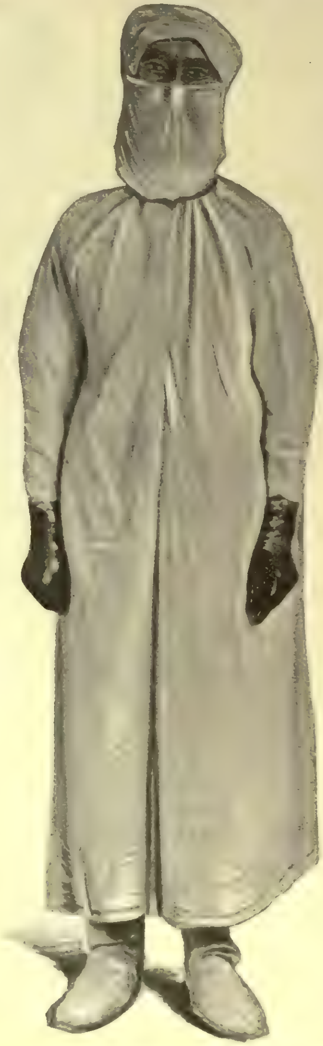


Fig. 76.—The complete dress of the operator.

suffering from a catarrh, a thick piece of cotton-wool should be placed under the mask to cover the nose and mouth; this will filter the expired air efficiently of all particles of moisture. It is hardly necessary to point out the real danger which may accrue from carious teeth, or from chronic suppurative conditions of the gums or of the respiratory passages. The operator's duty with regard to himself and his assistants is to see that no such source of infection is overlooked, and the routine use of the mask is an entirely necessary precaution. In addition, unnecessary conversation should be avoided while operating, and a fresh mask put on at intervals during a long spell of work.

While the operator is preparing for his work, the patient is being anaesthetized, preferably in a special room where quiet is ensured, and only the anaesthetist and a nurse need be present. When scopolamine-morphine narcosis has been practised, the patient comes to the anaesthetist drowsy and lethargic. If intra-dural anaesthesia is practised she then hardly feels the puncture; if inhalation anaesthesia is selected she takes it without resistance or choking, and the preliminary stage of excitement is seldom seen. She is brought into the theatre and laid on the operating table, with care and gentleness, before complete surgical anaesthesia has been attained, and the coverings are removed as soon as the stage of complete muscular relaxation has been reached. If an examination under anaesthesia is to be made this is the moment at which it is done; the operator afterwards re-sterilizes his hands and puts on a fresh pair of gloves for the operation.

The Position of the Patient.—This is a point of some importance. In operations on the abdomen proper, the horizontal position is the most generally suitable. In abdomino-pelvic operations the inclined or Trendelenberg position offers very important advantages. The inclined position, as Jayle has shown, was in use during the Middle Ages, and was figured by surgeons of that time; but its present widespread use is due to the powerful advocacy of Trendelenberg. The advantages are (1) that the pelvic cavity is cleared of coils of intestine and omentum which gravitate into the upper abdominal region; (2) the abdominal viscera can therefore, by packing, be completely protected from sources of infection in the pelvis; (3) illumination of the pelvic cavity is greatly facilitated; (4) manipulations in the depths of the pelvis are rendered possible under direct vision instead of by touch; (5) inhalation broncho-pneumonia is less likely to occur as the respiratory passages drain into the pharynx, which can be readily cleared.

Certain disadvantages must, however, be noted: (1) the weight of the patient's body has to be supported by shoulder-rests and by fixing the legs below the knees to the operating table; (2) in the case of stout persons considerable embarrassment

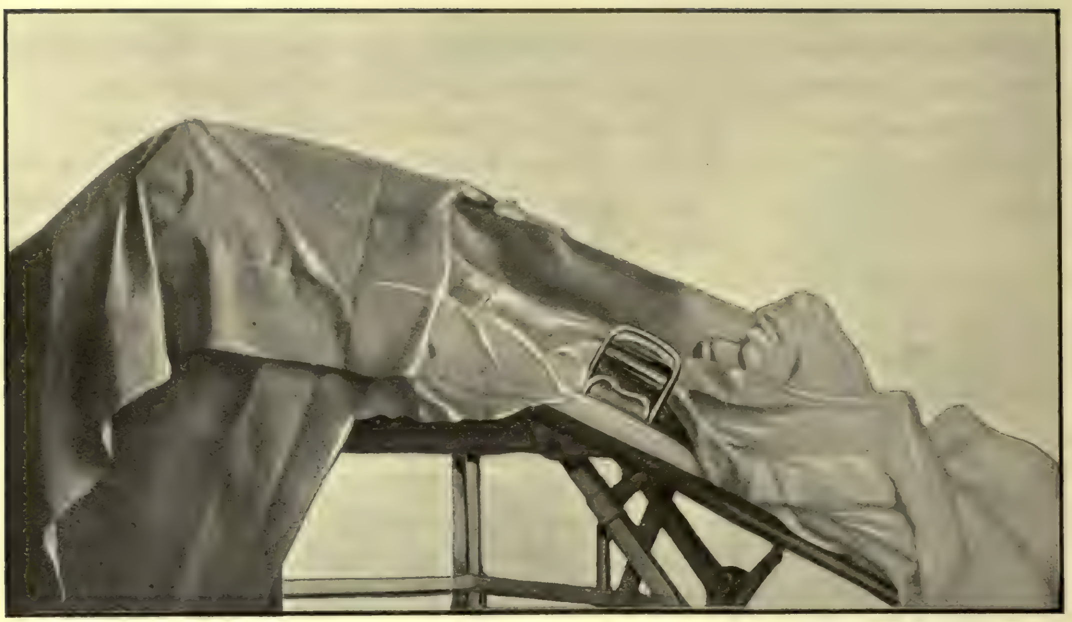


Fig. 77.—The medium Trendelenberg position.

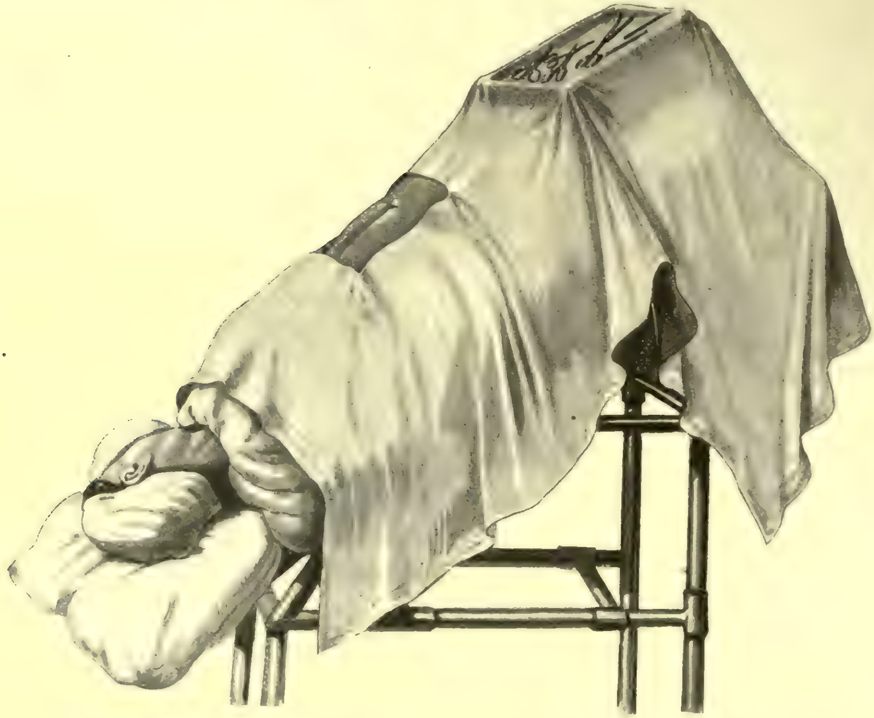


Fig. 78.—The complete Trendelenberg position. Bonney's instrument tray.

of respiration and of cardiac action results when the plane of inclination is acute, from pressure upon the diaphragm; aeration of the blood may accordingly become very deficient as evidenced by extreme cyanosis, and the right side of the heart may in consequence be a good deal hampered in its action.

The prolonged use of an acutely inclined position is therefore to be avoided; the operation may be begun in the horizontal or medium inclined position, and full inclination only made use of during difficult parts of the operation (Figs. 77 and 78). In order that the best use of the Trendelenberg position may be made, it is necessary to have a properly constructed operating table. This will therefore be a convenient moment to consider briefly what requirements an operating table should fulfil.

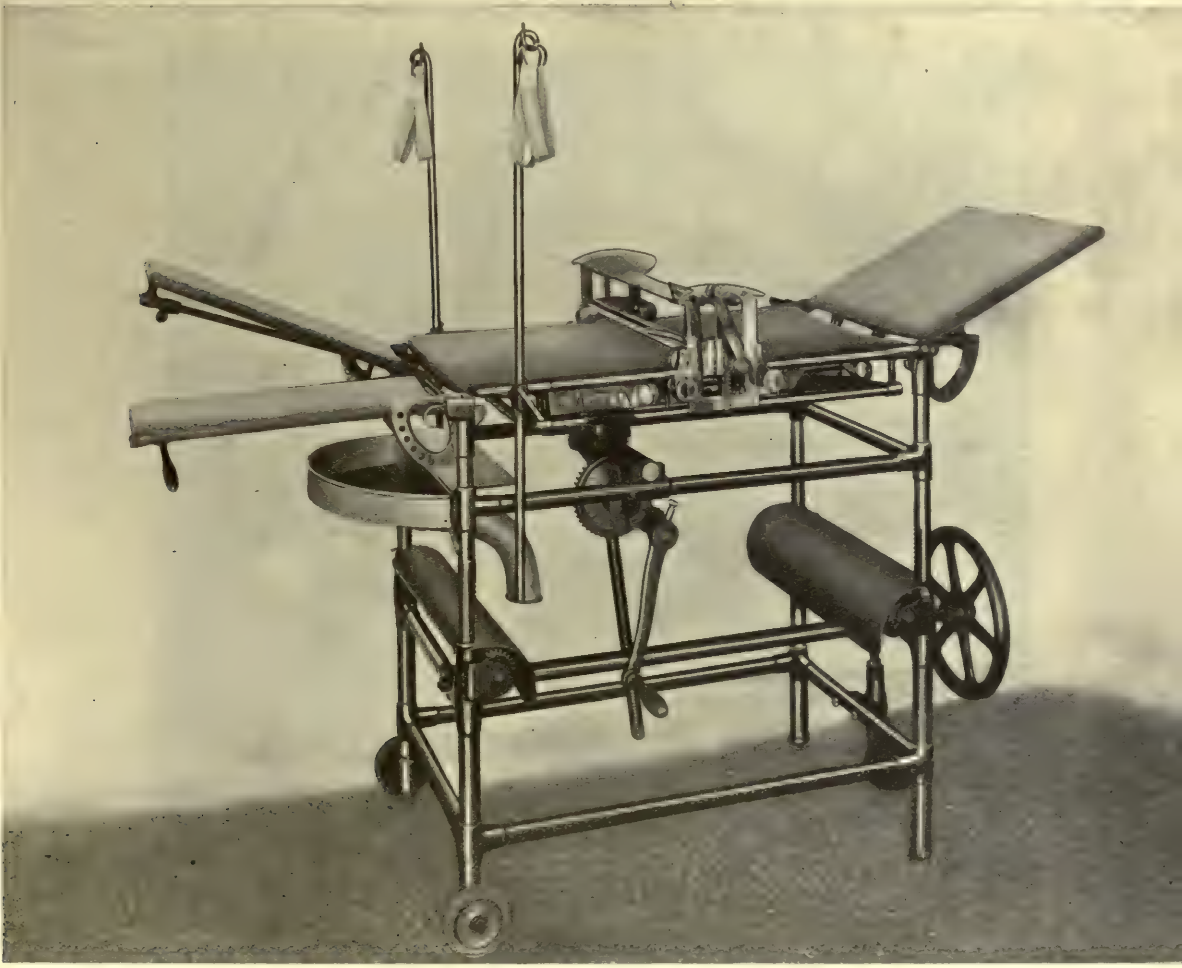


FIG. 79.—The movable operating table.

The Operating Table.—In the *first* place, it must be stable and strong; most 'portable' operating tables are unsatisfactory in these respects, for a table which will safely support a corpulent patient in the acutely inclined position must necessarily be very heavy. In the *second* place, it must be made of non-corroding metal which withstands a damp atmosphere and can be easily cleaned. In the *third* place, it should be capable of easy adjustment in horizontal level and in inclination, without disturbance to the patient. A *fourth* requirement is some means of artificially warming the table in order to diminish loss of body-heat. This may be done by introducing tins of warm water beneath the central part of the table, or an electric system of heating may be employed.

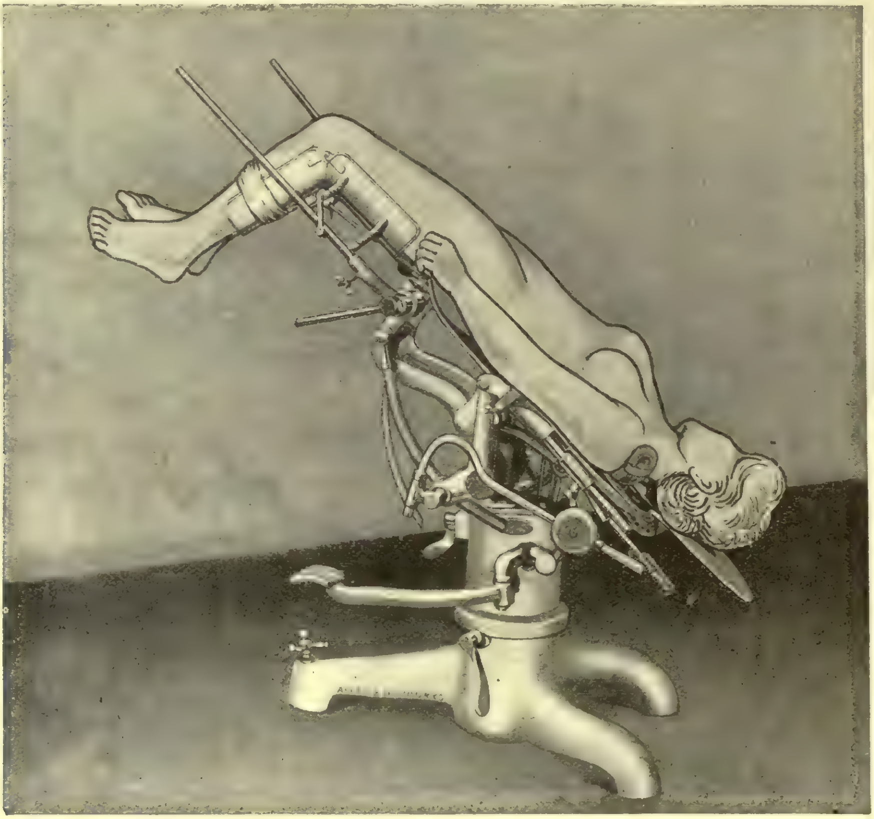


FIG. 80.—The pedestal operating table. Trendelenberg position.

Many different types of operating table which fulfil these requirements can be obtained, two of which are shown in Figures 79 and 80. The pedestal table is fixed to the floor, and is adjusted by means of foot pedals. The movable table travels on rubber-tyred wheels, which, however, can be raised by a lever and thrown the sides of the trunk, and the simple arm-rest devised by Paterson and shown in Figure 83 serves well to keep the arms in this position, where they are entirely protected from injurious pressure. Sterilized coverings of thin mackintosh are then laid on the thighs, the upper abdomen, and each flank ; over these is laid a large sterilized sheet, or 'body-cover,' furnished with a central oval opening measuring about 6 in. by 4 in. This conceals all the subjacent coverings from the chin to the knees, and leaves exposed only the area upon which the incision is to be made. The opening is adjusted over the area selected, and its edges are then attached to the skin with four small clips or with four stitches (Fig. 84). Or, instead of fixing the abdominal cover to the skin, two small sterilized towels may be clipped to the edges of the wound after the incision has been made, in the manner shown in Figure 85 so that no portion of the patient's skin is exposed during the subsequent stages. These towels can be readily changed as they become soiled during the operation.

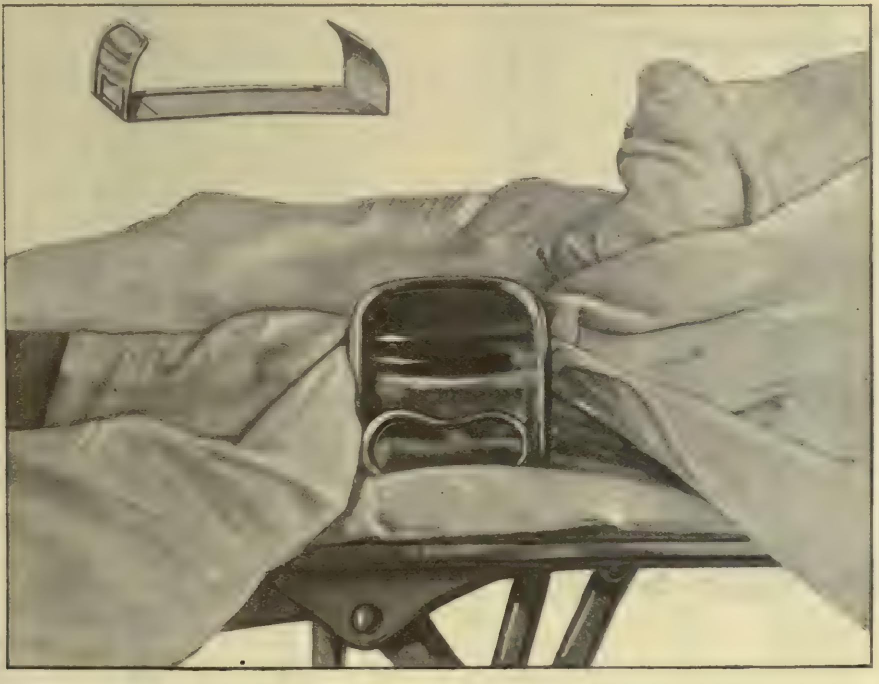


FIG. 83.—Paterson's arm-rest.

In vaginal operations the same care should be taken to isolate the field of operation ; it is true that the vaginal canal cannot be rendered aseptic, but organisms introduced from without probably show much greater virulence when introduced into vaginal wounds, or into the pelvic peritoneal cavity, than those whose normal habitat is the secretion of the cervix or vagina. The coverings shown in Figures 86 and 87 are those in use at the Chelsea Hospital for Women. The leg-covering is slipped over the leg-rest, and covers the whole of the lower extremity, including the groin and the buttocks. The body-cover is placed over the vulva and is fastened to the skin at four points, one between the vulva and the anus so as to cover the latter completely, one above the mons Veneris, and one at each side. Below, the cover is long enough to fold over the receptacle, and in consequence the entrance to the vagina is as completely isolated as is the abdominal opening for coeliotomy. It takes barely a minute for these coverings to be arranged.

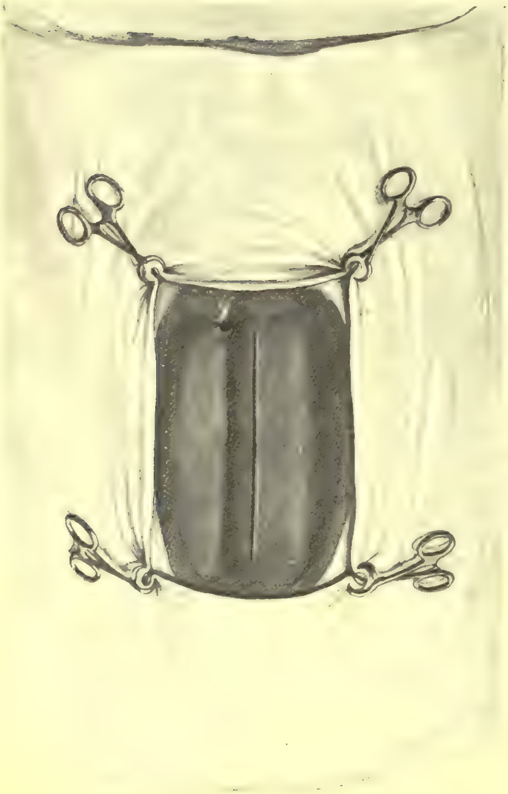


FIG. 84.—The operation-field. Towels clipped to the surrounding skin.

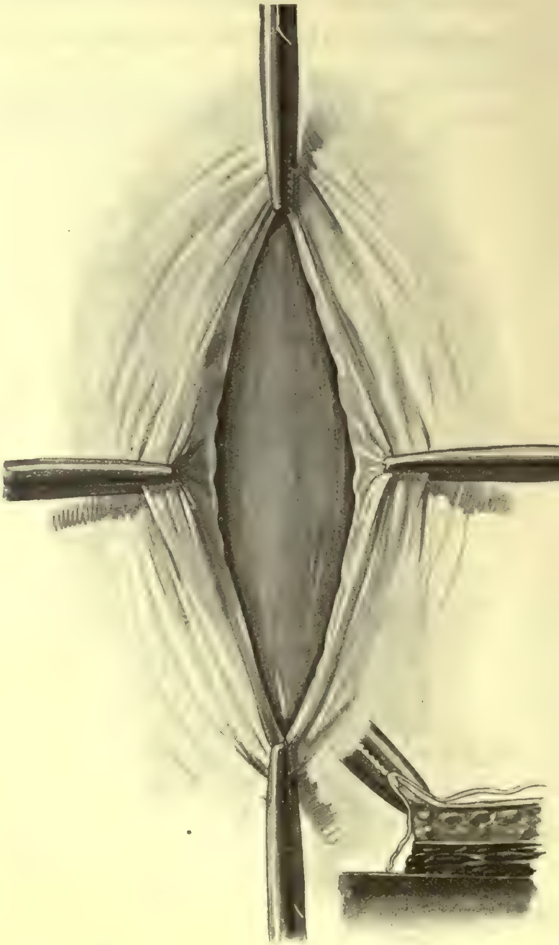


FIG. 85.—Towels clipped to the skin-edges of the wound.

When once the abdomen has been opened it is important, in many pelvic operasharp teeth upon the tips of this forceps give a secure hold without severely crushing the included tissues (Fig. 88, *b*). Long artery forceps with short curved blades, as used by Moynihan for the gall-bladder, will be found especially convenient for pelvic work. Long-handled ring forceps, and the long-toothed dissecting forceps (Fig. 88, *c*), are also very convenient for dissection in the depths of the pelvic cavity. Long scissors, both angled and curved on the flat, are also wanted for these deep dissections.

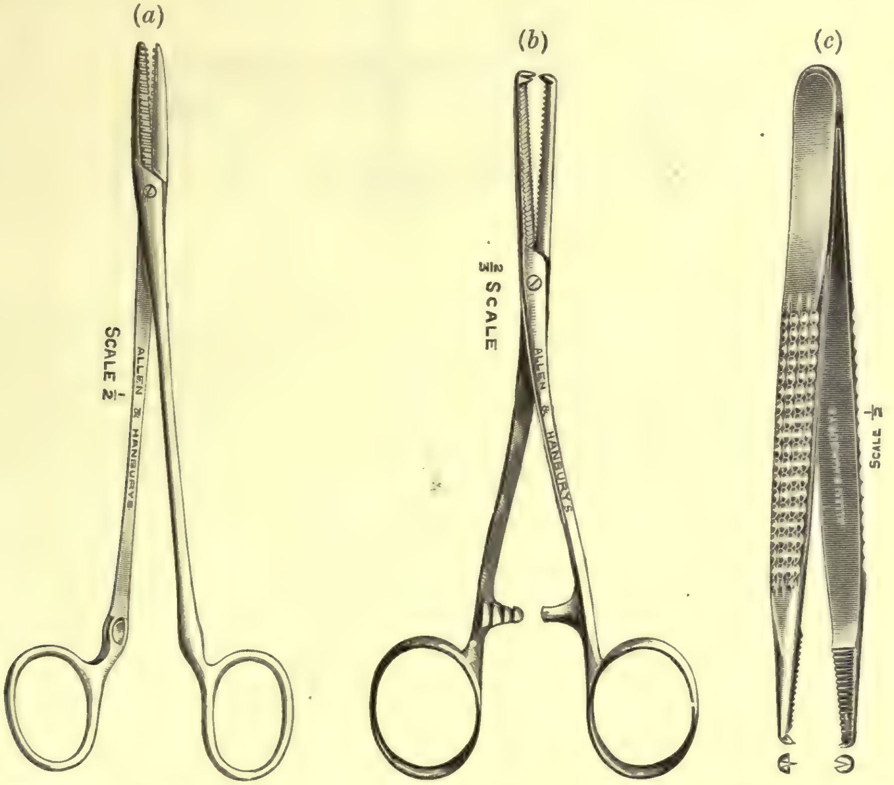


FIG. 88.—(*a*) Long haemostatic forceps. (*b*) Kocher's forceps. (*c*) Long-toothed dissecting forceps.

A mechanical retractor for separating the edges of the parietal incision is a valuable means of saving time and facilitating intraperitoneal work; it is to be preferred to retractors held by assistants, for the reason that the latter necessitates the presence of an additional assistant; the mechanical retractor therefore saves a pair of hands. An abdominal retractor should embrace the whole thickness of the parietes, it should not exert pressure to an extent likely to be injurious, and its bulk should be reduced to the minimum. In the opinion of the writer the retractor of Gossett best fulfils these requirements (Fig. 89). The retraction is effected by metal loops, not by broad blades, and consequently the area of tissue actually compressed is very small. It is not a rigid instrument, for the retractor yields to the tension of the separated parietal edges, as the blades are not held apart by a ratchet. The instrument is light in weight, and takes up a very small amount of room in the

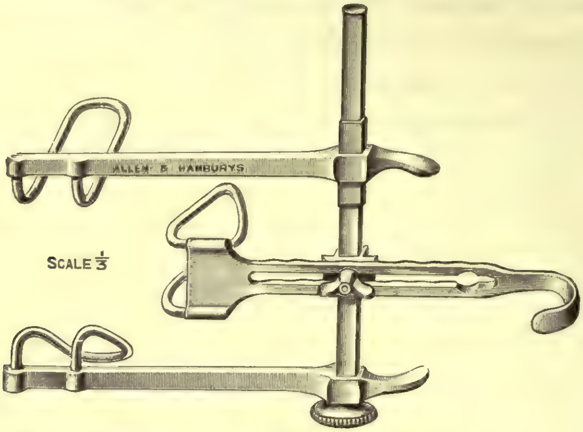


Fig. 89.—Gossett's retractor.

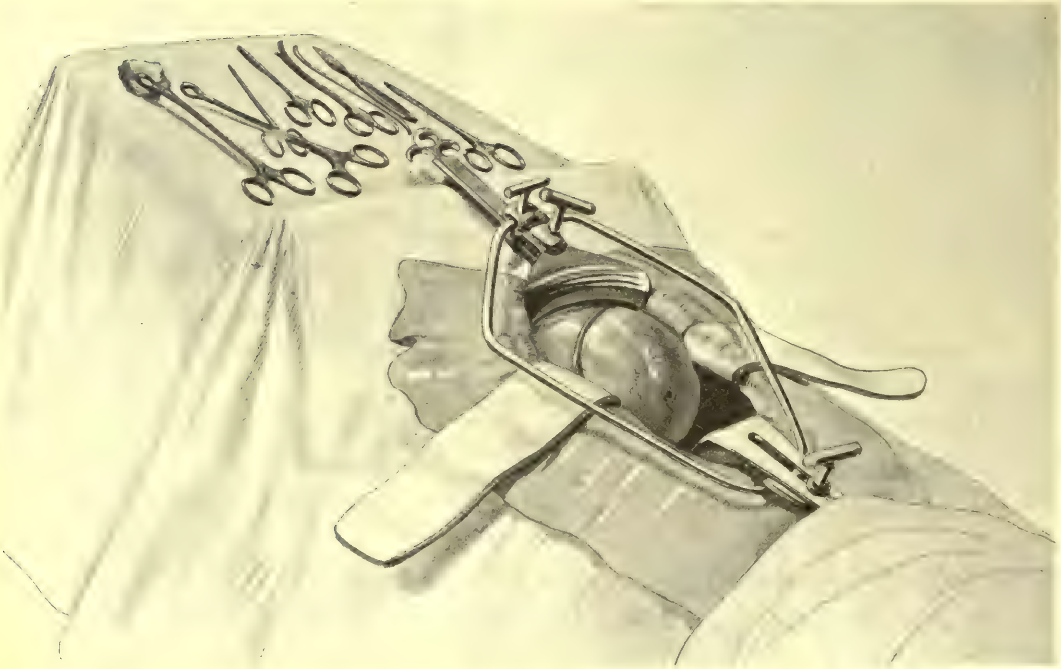
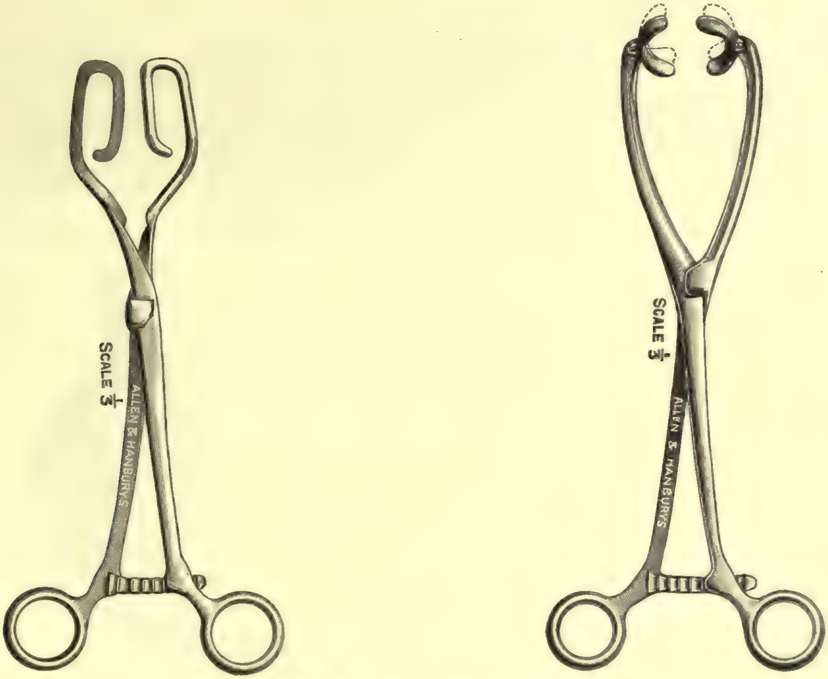


Fig. 90.—The preparatory stage of a hysterectomy (drawn from life), showing Faure's retractor in position and the wound-edges protected by Oldfield's double rubber collar. (From Lockyer's ***Fibroids and Allied Tumours***, Macmillan, 1917.)

operation-field. A detachable blade working on the transverse bar is useful in retaining the packed intestines in the upper abdominal cavity. The instrument *in situ* is shown in Figure 106, p. 340.

Many other types of abdominal retractor may be used. Most of them are very powerful, and are therefore liable to injure the vitality of the parietal tissues, and so hinder the proper healing of the wound, or render it more liable to infection. One of the best of these is the retractor of Faure (Fig. 90). It consists of a broad curved valve which fits into the pelvic extremity of the wound and is held in position by being clamped to a metal support which rests between the thighs. A second smaller blade retracts the upper angle of the wound and is clamped to a light metal frame. It is much bulkier and more rigid than Gossett's pattern.



Figs. 91 and 92.—Dartigues' uterine forceps.

The injurious effects of prolonged pressure upon the abdominal wall may be mitigated by interposing layers of sterilized gauze or the double rubber collar shown in Figure 90 between the blade of the retractor and the cut surfaces.

Special forceps are useful for making traction on the uterus, when adhesions involving the uterus or the adnexa have to be separated. The two patterns shown in Figures 91 and 92, both associated with the name of Dartigues, serve this purpose admirably inasmuch as they inflict no injury whatever upon the uterine tissues

(Fig. 113, p. 358). Strong volsella forceps are required in the operation of supravaginal hysterectomy for seizing and pulling up the cervical stump.

In dealing with injuries to soft-walled organs lying deeply in the pelvis, such as the bladder or the bowel, crushing forceps must of course be avoided. The walls may be seized with long Kocher's forceps, or better still a stout ligature may be passed through the wall at two points, and these ligatures used to pull up the involved area within reach. In passing these ligatures the small right-angled needle shown in Figure 93 is very useful (Thomson Walker). The shaft is flexible, and consequently by bending it the needle may be more conveniently directed into positions difficult of access. Reverdin's angled needle is of the greatest service in understitching deeply situated points, or in introducing a running stitch in the floor of the pelvis.

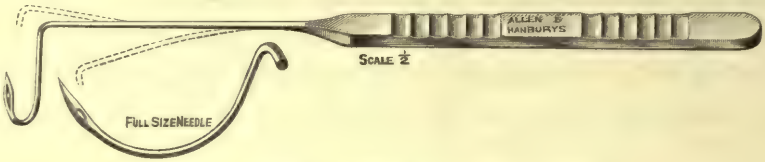


FIG. 93.—Thomson Walker's ureteral needles.

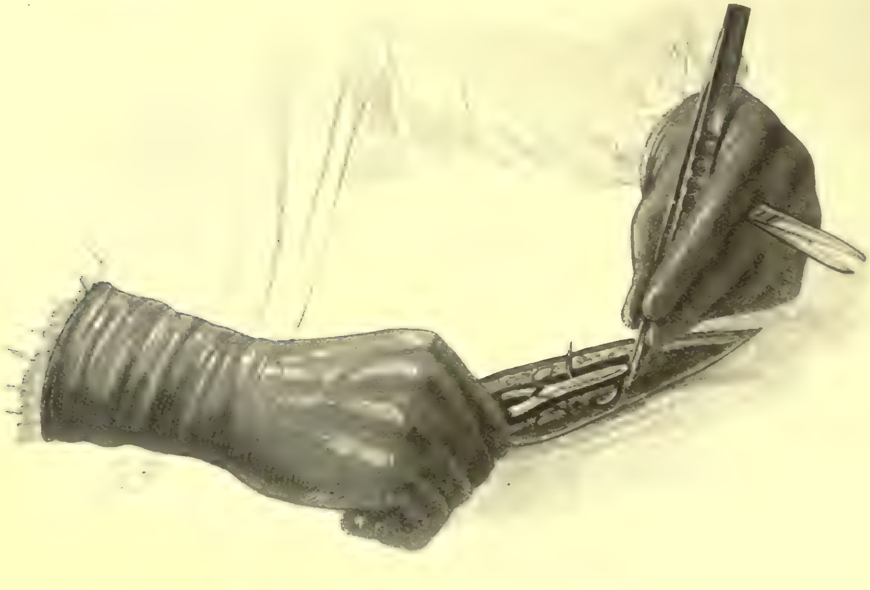


FIG. 94.—The use of Reverdin's needle.
The operator is passing the needle through the edges of the aponeurosis.

An important point in operative technique is that ligatures, especially those which are non-absorbable, should be handled as little as possible. Threading of

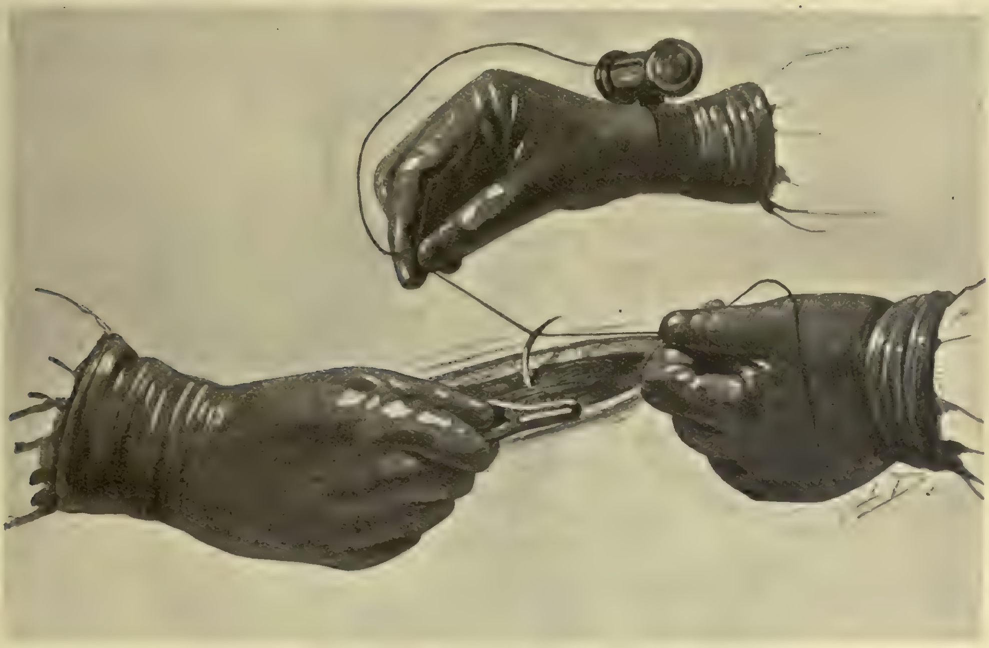


FIG. 95.—The use of Reverdin's needle. The operator has passed the needle through the edges of the aponeurosis, the assistant threads the slot from the reels.

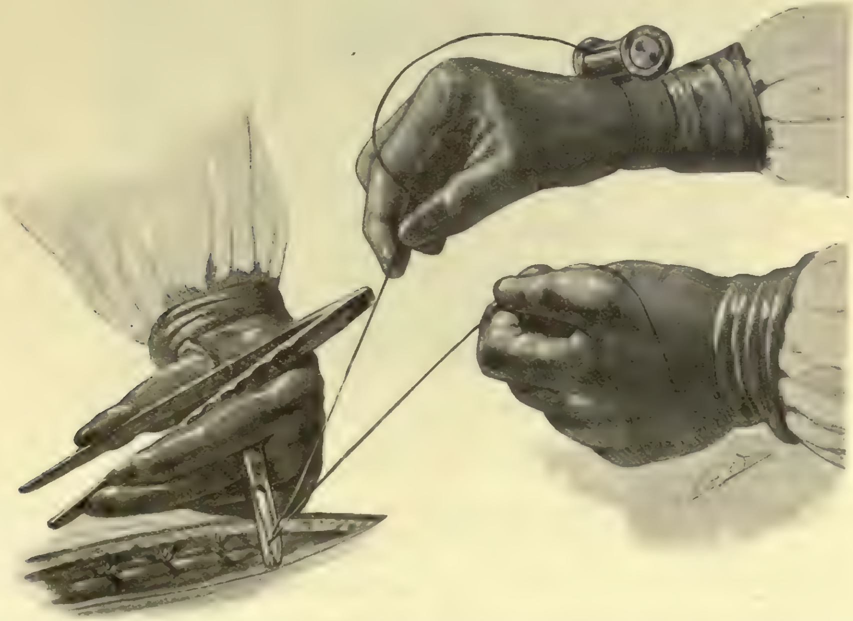
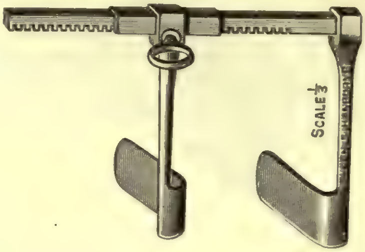


FIG. 96.—The assistant has tied the ligature, the operator divides it with scissors held in the palm.

needles by an assistant can be to a great extent eliminated if the operator uses Reverdin's slot needles shown in Figure 94. When used in conjunction with the wrist-reels shown in Figure 95 (Bonney) no one but the operator and his chief assistant need touch the ligatures at all. The reels are loaded with lengths of prepared thread or catgut, and kept in an antiseptic solution until required; a reel



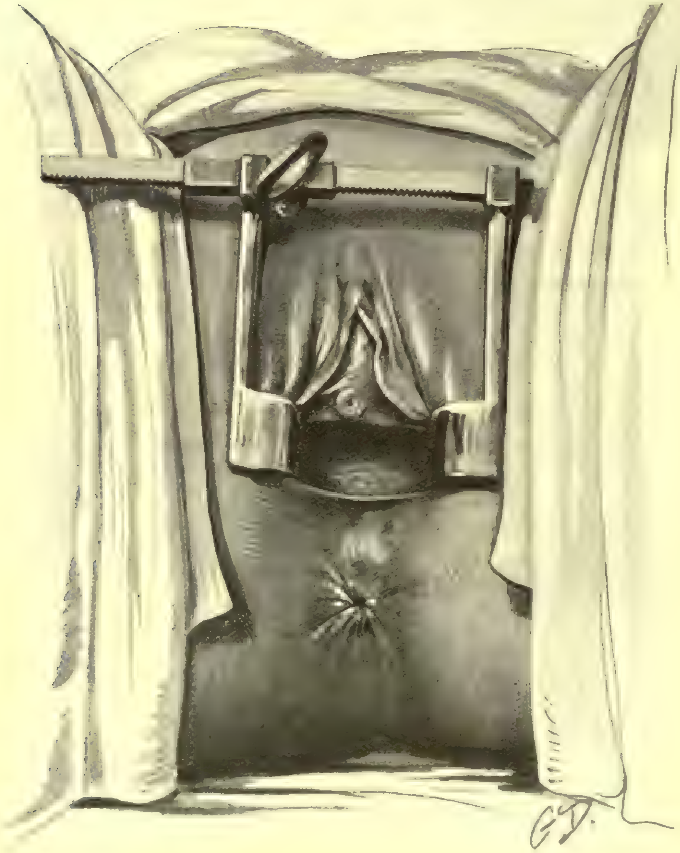


Fig. 97.—Jayle's vaginal retractor in position.

is then introduced into its holder, and the end of the ligature pulled through and passed between the fingers. When two reels are used, one is for catgut the other for thread or silk. Sutures in deeply-lying structures can thus be placed with ease, or the abdominal incision rapidly closed.

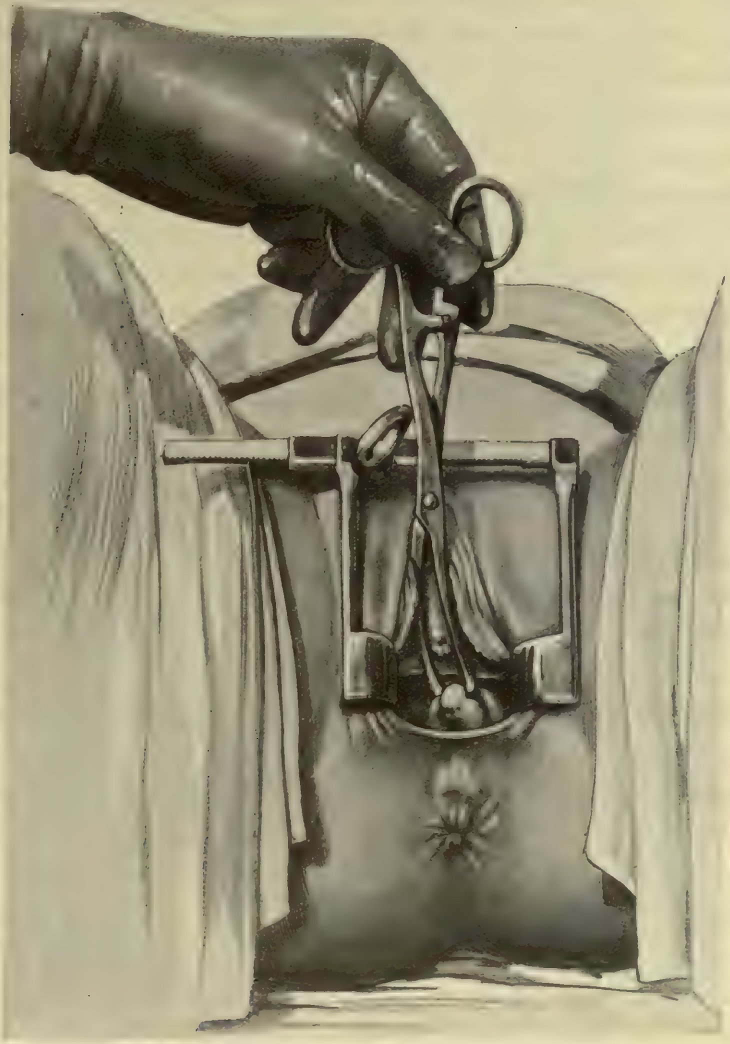


FIG. 98.—The cervix exposed with Jayle's retractor and a volsella.

In the course of a pelvic operation the surgeon must always be prepared to deal with injuries of the intestine, the bladder, or the urethra. Two pairs of intestinal clamps should therefore be at hand at all times, and also the needles and other instruments required for enterorrhaphy or uretero-vesical anastomosis.

In a vaginal operation the exposure of the deeply-lying parts of the canal is a matter of some importance. Depression of the posterior vaginal wall and perineum by some form of duckbill or spatula speculum is the classical method, and this must be supplemented by the use of long, narrow, metal spatulae for the lateral and anterior walls. A very serviceable mechanical vaginal retractor has been devised by Jayle (Figs. 97 and 98). When used in conjunction with a posterior retractor it serves to expose the cervix and the vaginal roof, and greatly facilitates operation upon these parts when they cannot be drawn down to the vulva by traction. The wide separation of the labia enables the operator to avoid contact completely with these surfaces during his work.

The Abdominal Incision.—Short incisions are, as a rule, to be deprecated. The main object of the abdominal incision is freely to expose the site of the disease. Insufficient room carries with it many disadvantages: thus it prevents a proper inspection being made of the diseased areas; it prolongs the operation by making the manipulation more difficult; it often requires the operator to use an unnecessary amount of force; it hampers him in making that exploration of distant organs which may be called for, and in this way has often led to gross lesions being overlooked. A long incision is no more likely to become the seat of hernia than a short one, nor is it more likely to become infected. The sole argument in favour of the 'button-hole' incision is the so-called cosmetic advantage of the inconspicuous scar.

The knife used for making the parietal incision should be laid aside and another used for intraperitoneal work; this avoids the risk of direct implantation of skin organisms.

In planning an abdominal-coeliotomy incision the following objects should be kept in view: (*a*) to allow free and easy access to the site of the disease, (*b*) to inflict the least possible injury upon the parietal structures, especially the motor nerves, (*c*) to reduce to a minimum the risk of subsequent hernia, (*d*) to occasion the minimum of disfigurement. In operations upon the pelvic organs a sub-umbilical incision is, as a rule, sufficient, and it may be made in one of the following positions: (1) in the mid-line, (2) an inch to the side of the mid-line (*paramedian*), (3) in the semilunar line (*vertical lateral*), (4) in the direction of the fibres of the external oblique muscle (*oblique lateral*), or (5) across the plane of the body (*transverse*) (Fig. 99).

1. *The Median Incision* is made by cutting through the whole of the abdominal wall in the mid-line of the body. In the subcutaneous fat, vessels of considerable size may be cut, and just above the pubes an arterial branch from the superficial pudic artery usually requires a ligature. Most of the bleeding points are small, and can be crushed with artery-forceps and twisted at a later stage of the operation; all vessels of considerable size should, however, be tied. After dividing the skin and

the aponeurosis, the edges of the recti muscles are separated from one another, exposing the subperitoneal fat. In a parous woman this usually requires no cutting; in a nullipara a few touches of the knife may be required to free the muscles from the thin layer of fibrous tissues which constitute the linea alba. After repeated child-bearing this fibrous septum is never seen. The division of the skin and subcutaneous fat should extend below as far as the pubic bone, and upwards towards the umbilicus as far as may be necessary; extension downwards gives the operator the freest possible access to the pelvic cavity. If the bladder has been emptied the subperitoneal layers (including the transversalis fascia) can be carefully

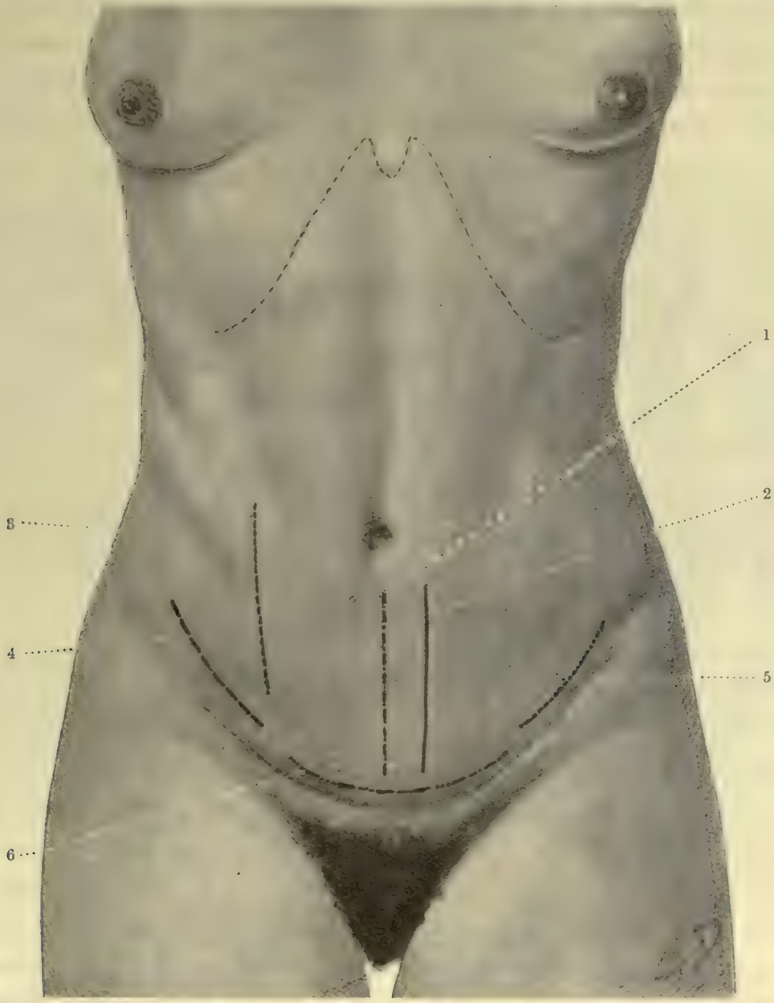


FIG. 99.—The abdominal incision.

1, Median; 2, paramedian; 3, in semilunar line; 4, gridiron for appendix; 5, gridiron for inguinal colotomy; 6, transverse.

divided as close to the pubes as the superficial structures. Sometimes small arterial branches may be divided in cutting the aponeurosis or the muscle, but the subaponeurotic structures in the middle line are comparatively non-vascular. If the tissue at the lower end of the peritoneal incision bleeds freely the operator knows that he is upon the fundus of the bladder.

In dividing the peritoneum the obliterated umbilical veins forming the urachus are usually seen as a thin, white, cord-like structure running in the subperitoneal cellular tissue. The recognition of this structure indicates that the incision is above the level of the fundus of the bladder, and the tissues can be cut without fear of wounding this organ.

In dealing with tumours of large size the median incision can be easily extended upwards as far as may be necessary; it should be carried round the side of the navel into the mid-line above it. It is undesirable to cut through the umbilicus, as its dense tissues and depressed surfaces are unfavourable to healing. Some operators excise the navel, but this produces an unnecessary disfigurement.

The advantages of an incision in the mid-line are (*a*) that the fewest number of vessels and nerves are divided, (*b*) that there is no injury to the rectus muscle, (*c*) that the technique is extremely simple. The sole disadvantage is that the resulting cicatrix is very weak. It depends for its resisting power mainly upon the aponeurosis covering the recti muscles. It will be recollected that somewhat below the level of the umbilicus the rectus muscle has no aponeurosis beneath it; the deep layer of the rectal sheath ceases at this level, and the superficial layer is exceptionally strong, as the fascial insertions of the oblique and transversalis muscles do not split to enclose the rectus, but pass entire in front of this muscle. The general direction of the cutaneous and aponeurotic fibres is transverse; they are therefore divided at right angles to their course, and the natural pull of the tissues consequently causes the wound to gape and increases the tension upon the stitches when it is closed. If good union of the divided aponeurosis is secured the resulting scar will not yield to any great extent, but a certain amount of stretching of the cutaneous cicatrix always takes place subsequently. If good aponeurotic union is not obtained hernia is inevitable, for there is no other structure in the median plane which is capable of resisting intra-abdominal pressure. Cases in which the parietal musculature has been enfeebled by child-bearing, or in which a drainage tube is employed, or in which suppuration occurs in the wound, yield a high percentage of subsequent herniae with this incision.

2. *The Paramedian Incision.*—This incision is made one inch or an inch and a half to one side of the mid-line. After opening the rectus sheath the muscle-fibres

may be divided by cutting, or separated by blunt dissection, and the transversalis fascia and peritoneum then opened, all the parietal layers being thus divided in the same line. In this method the nerve-supply of the muscle-fibres upon the median side of the incision is necessarily cut off, and it has been shown that these fibres undergo extensive post-operative atrophy (Assmy). The advantage of avoiding the mid-line is therefore to a great extent counterbalanced by the permanent injury to the muscle which is produced.

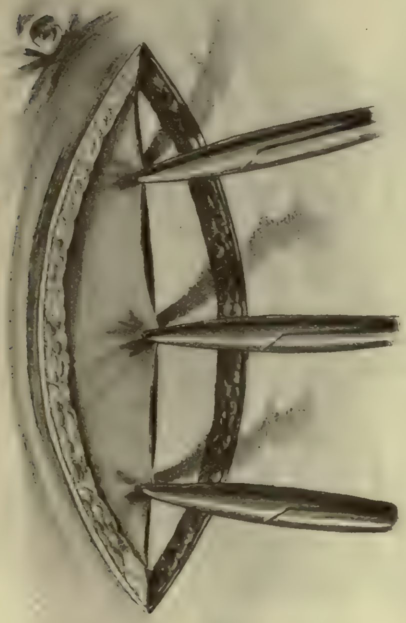


Fig. 100.—The paramedian incision. Skin and aponeurosis have been divided.

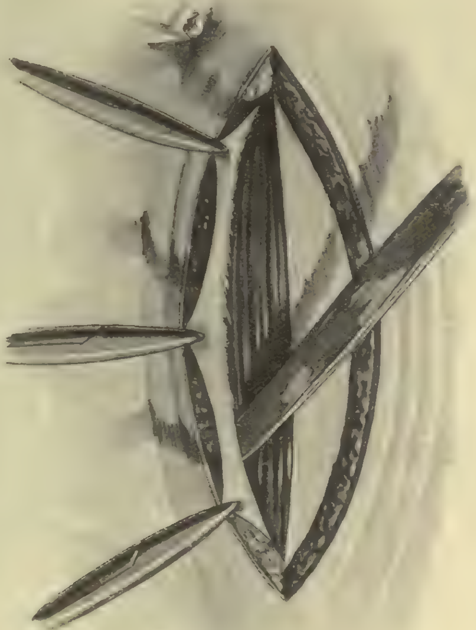


Fig. 101.—The paramedian incision; clearing the edge of the rectus muscle.

A modification of the paramedian incision was introduced by Lennander, His method is, after opening the rectus sheath, to detach the aponeurosis up to the mid-line (Fig. 101), separate the muscle from its fellow, and then retract it. so that the peritoneum can be opened in the same line as the rectus sheath (Fig. 102). This method avoids injury to muscle-fibres and to their nerve-supply, and at the same time strengthens the scar by interposing a layer of uninjured muscle between the peritoneal and fascial planes of the incision. From the point of view of preventing post-operative hernia it is ideal; its sole disadvantage is that it does not allow equally easy access to both sides of the pelvis. The operator can, however, choose the side which seems most suitable for each case. As a rule the right side should be selected, in order that the appendix may be more readily examined and removed if necessary. When this incision is practised upon a nulliparous woman with intact recti, the muscles cannot be separated from one another entirely by blunt dissection, but a few nicks with the knife are required to free them from the linea alba. In a multipara with a weak abdominal wall the edges of the recti may both be exposed and

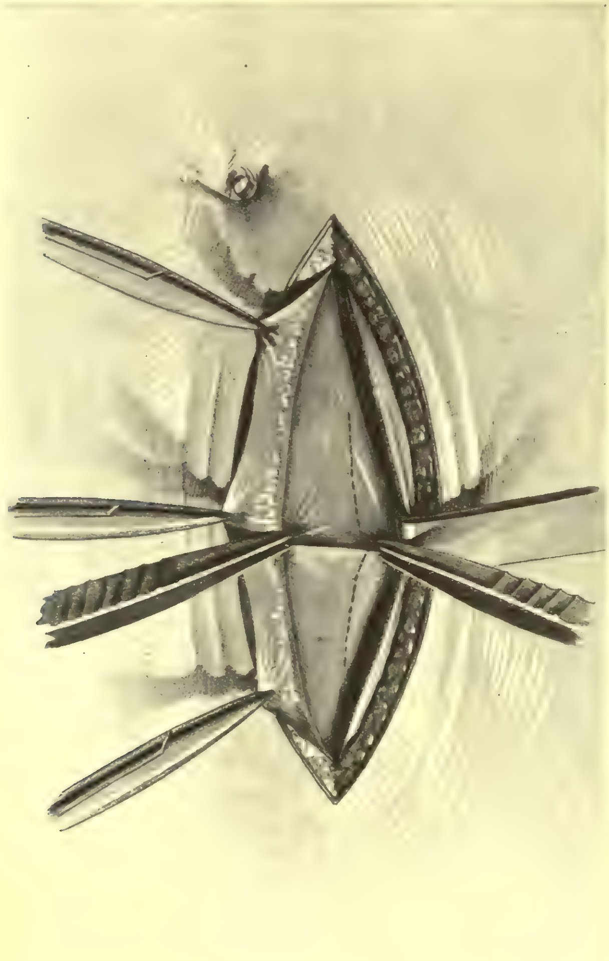


FIG. 102.—The paramedian incision; dividing the peritoneum. The edge of the left rectus is retracted.

subsequently stitched together when suturing the wound. In a nulliparous woman the linea alba is represented by a definite fibrous band to which the edge of the muscle may be stitched.

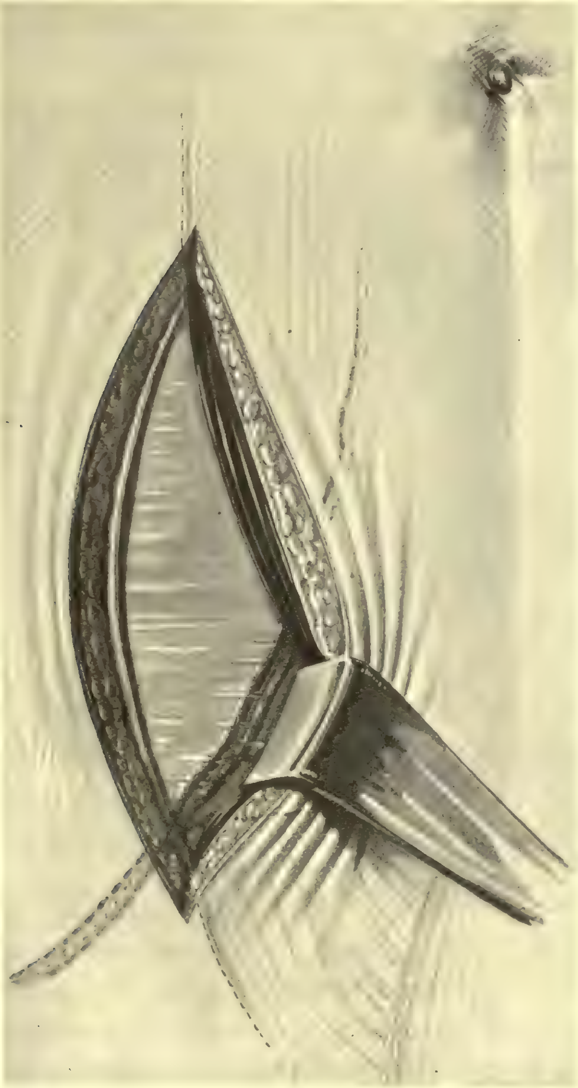


Fig. 103.—The incision in the semilunar line, showing the course of the deep epigastric vessels.

3. *The Lateral Vertical Incision.*—A third modification of the paramedian incision is that which is made a little internal to the *outer* edge of the rectus (*linea semilunaris*). After opening the sheath the outer edge of the muscle is sought and retracted towards the middle line ; the transversalis fascia and peritoneum are then

divided in the same line as the rectus sheath. On the right side a two-inch incision, beginning above at the level of the umbilicus, is very convenient for cases of appendicitis, and causes less injury to muscular structures than the ‘ gridiron ’ incision. If extended downwards towards Poupart's ligament it gives good access to the right side of the pelvic cavity, and further, with a lax and thin abdominal wall the left adnexa can be removed without difficulty. In extending this incision downwards the deep epigastric artery will be encountered ; by raising the rectus muscle it can be seen running beneath it, and can be picked up and divided between two pairs of forceps (Fig. 103). Here nerve-filaments of considerable size may be found entering the under surface of the muscle : they should be drawn aside and protected from injury.

4. *The Oblique Lateral Incision.* (*Gridiron Incision.*)—This incision is practised upon the right side for dealing with the vermiform appendix, upon the left side for inguinal colotomy. It is made about two fingerbreadths external to the anterior superior spine, and runs from above downwards and forwards in the same direction as the fibres of the external oblique muscle, *i.e.* parallel to Poupart's ligament. A two-inch incision, beginning above at the level of the umbilicus, is sufficient for the appendix. The aponeurosis of the external oblique is first exposed and then laid open by an incision in the direction of its fibres. This exposes the internal oblique and transversalis muscles, the fleshy fibres of which are then separated by blunt dissection along a line roughly at right angles to the skin-incision. Lastly the transversalis fascia and peritoneum are divided in the same line as the internal oblique. The parietal planes are thus divided in different directions, and the scar-tissue is formed along lines which intersect one another, and thus give an unusually strong scar. A certain amount of injury to the nerve-supply of the muscles is, however, necessarily inflicted by separation of the fibres, and the amount of room allowed for manipulation is small.

5. *The Transverse Incision.*—This incision was introduced by Küstner and afterwards improved by Pfannenstiel. The former divided only the skin and subcutaneous fat transversely ; the rectus sheath and the structures beneath it he divided longitudinally in the mid-line. Pfannenstiel's modification consisted in dividing the rectus sheath in the same line as the superficial structures ; this is the manner in which the incision is now generally practised.

The line of incision is usually placed about one inch above the upper border of the pubes, and is slightly curved in its central part towards the symphysis ; it extends from the linea semilunaris of one side to a corresponding point upon the other (Fig. 104). A considerable number of vessels are divided, and all bleeding points must be carefully tied. The rectus sheath is then opened transversely with a knife over the centre of each muscle; the edges of the sheath are picked up with forceps; and the division completed from end to end of the incision. As the lateral border of the muscle is approached vessels of considerable size are encountered immediately beneath the aponeurosis, and here careful haemostasis is required. The upper and lower edges of the aponeurosis are then picked up with clips, and the muscle-fibres gently detached both upwards and downwards from the under surface with the finger covered with a swab; the linea alba must be freed from the aponeurosis with knife or scissors. Thus a broad band of muscle, including both recti, is laid bare. With a stout silk suture passed through the aponeurosis the upper flap is then stitched at two points to the skin below the umbilicus; this retracts it in bulk and exposes the incision freely. The recti muscles are next separated in the mid-line, mainly by blunt dissection, and the transversalis fascia and peritoneum opened also in the median line. The recti, being freed from their aponeurotic coverings, can be readily retracted, and offer much less resistance than with the longitudinal incision.

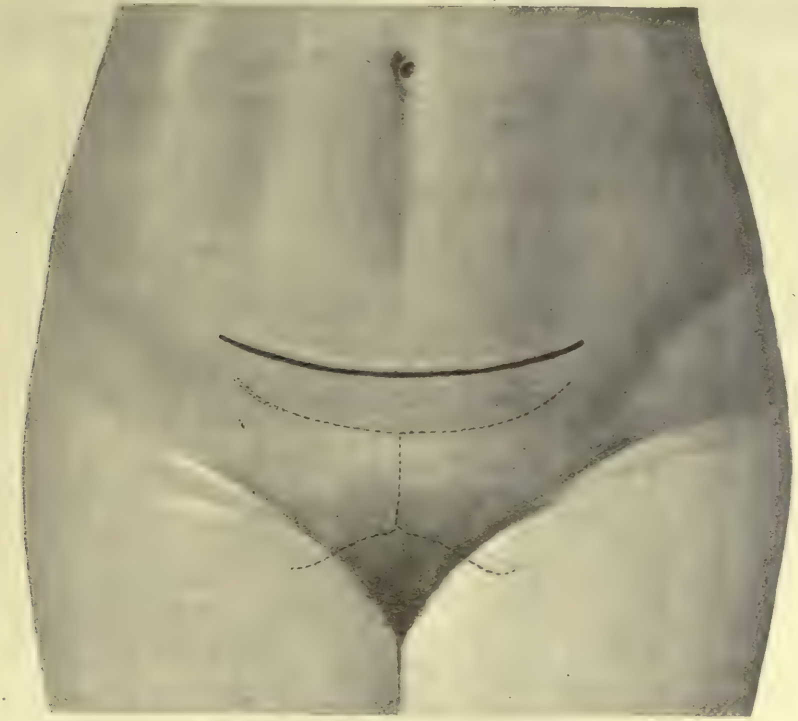


FIG. 104.—The transverse incision.

The amount of space provided by this incision is limited, and once made it can only be increased by dividing the muscles themselves; this may be done if required, and careful suturing subsequently gives firm union. But in dealing with tumours of some size it is better to make the incision at a higher level, about half-way between

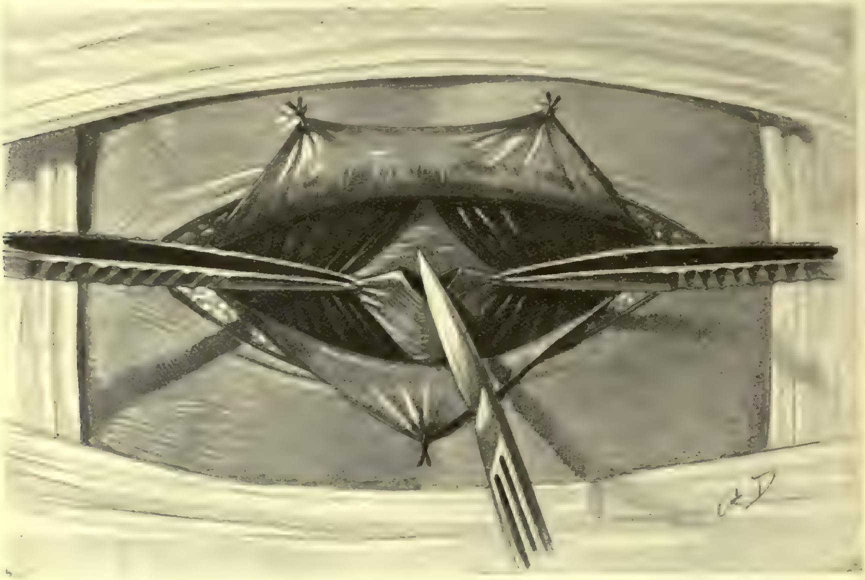


Fig. 105.—The transverse incision.
Dividing the peritoneum in the middle line.

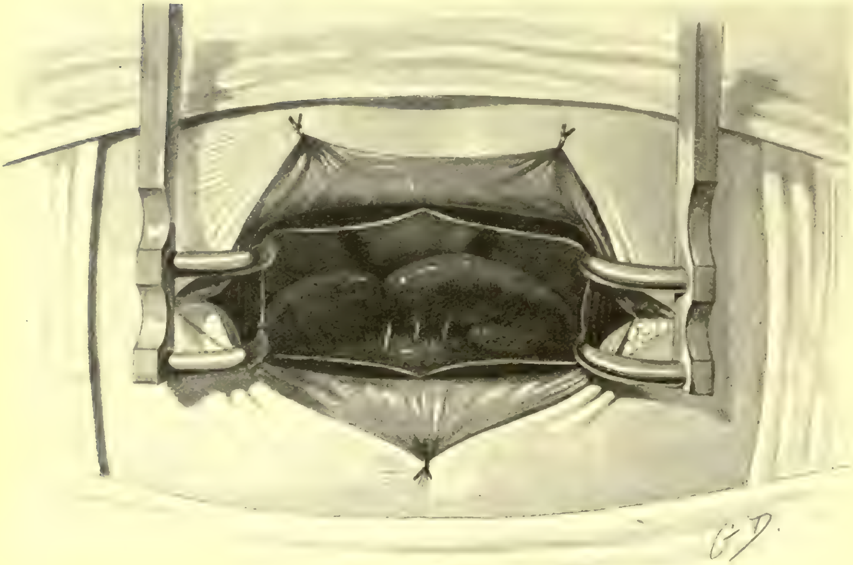


Fig. 106.—The transverse incision.
Gossett's retractor in position.

the pubes and umbilicus. The lower flap can then be freed farther down, and retracted with a skin-suture in the same way as the upper one; this allows the recti to be widely separated by retractors, and greatly increased space is obtained. The incision through the skin and fat can also be prolonged outward beyond the linea semilunaris on each side so as to allow better retraction of the flaps.

In suturing this incision the peritoneum and transversalis fascia form the deepest layer, and next the edges of the recti are brought together. Then the transverse incision in the sheath is united at right angles to the former, and lastly skin and subcutaneous tissue in the same plane as the sheath. At each plane all oozing points must be thoroughly secured, and especial care taken to control bleeding points beneath the rectus sheath, or a haematoma will subsequently form in this situation. Owing to the extensive separation of the parietal layers, an unusual amount of serous oozing occurs during healing; a fine drain-tube may be laid beneath the aponeurosis, and stitched to one corner of the incision (Fig. 107).

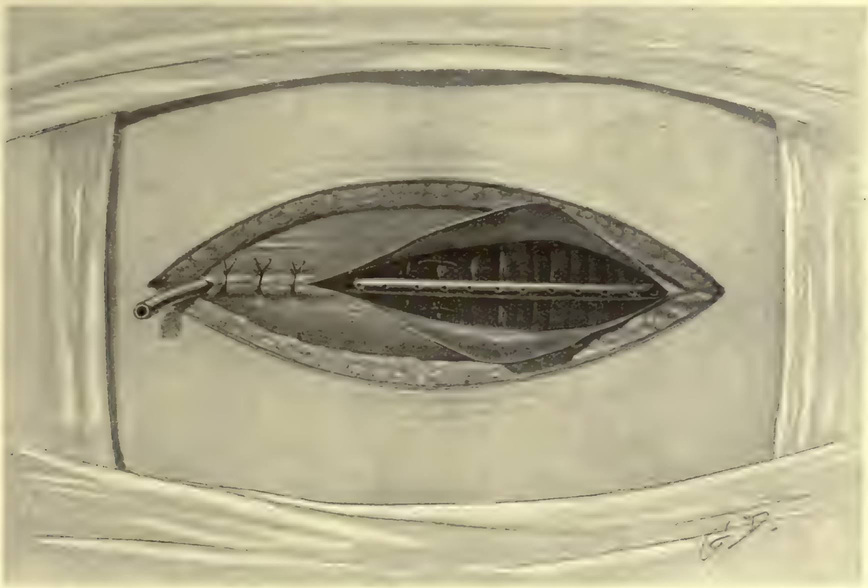


Fig. 107.—The transverse incision.
The recti have been united, the fascial stitches have been begun, and the drainage tube is in position.

The great advantage of this incision is the strength of the resulting cicatrix. There is no injury to muscle-fibres or to their nerve-supply; both the skin and the sheath are divided in the line of their constituent fibres, not at right angles to them as in all longitudinal incisions, and therefore the tendency of the edges to retract is reduced to a minimum, and the uniting stitches are free from tension. From the point of view of the prophylaxis of hernia there is no doubt that it is ideal, and it is claimed that hernia is unknown after this incision. A second and minor advantage is that when made low down the scar is, ultimately, entirely concealed by the pubic hair.

There are, however, several disadvantages to be borne in mind. The transverse incision takes longer both to make and to close, and, owing to the large number of vessels divided, want of care in haemostasis is sure to result in the formation of a haematoma, either beneath the skin or within the rectus sheath. Again, the amount of space which it gives is limited and cannot be increased except by dividing the recti. Lastly, if drainage is required, and a tube is brought out through the centre of the wound, the main object of the incision is defeated ; it is better to rely upon vaginal drainage alone. From this it follows that the transverse incision is unsuitable for cases in which a general abdominal exploration may be required, or in infected cases likely to require drainage. Should the wound become infected, widely diffused suppuration may occur within the rectus sheath.

Local Anaesthetics: Crile's Anoci-association.—The general principles upon which is based the combined use of general and local anaesthetics is discussed in the Article on Anaesthetics (p. 369). We are here concerned with the technique, and certain considerations which arise in connection with technique. The writer has made fairly extensive use of Crile's method for the past two or three years, and what follows is the outcome of his personal experience.

The solutions required are a 0·25 per cent solution of novocain, and a 0·5 per cent solution of hydrochloride of quinine-urea. These must be sterile, and normal saline should be used as the solvent, not plain sterilized water. The reason for this will be mentioned later. A convenient method is for the operator to provide sterile capsules containing a concentrated solution, which can be diluted to the required amount at the time of the operation. As both salts are readily soluble, small capsules containing 20 minims will suffice to provide from 4 to 6 ounces of the solution required.

The first injection (novocain) is made immediately beneath the skin ; a long needle set at right angles to the syringe is employed, and slowly pushed in up to its full length, the solution being meanwhile injected in advance of the needle point (Fig. 108). Visible distension of the subcuticular tissues is produced along the track of the needle, and the solution can be further distributed by firm pressure with a swab. If the incision is to be a long one, injection at two or three points must be made, and from a half to one ounce of solution is required. After waiting for two to three minutes the incision is then made through the skin and subcutaneous fat of the infiltrated area, for the whole of the required length. All bleeding points are picked up, and before tying them the second stage of the injection, *i.e.* into the rectus sheath, is made in the same manner (Fig. 109); here the fluid diffuses more readily and a smaller quantity is sufficient. Before the aponeurosis is divided the subcutaneous bleeding points are tied; special care is called for in haemostasis as bleeding is undoubtedly unusually free from the vessels in the infiltrated areas. The rectus sheath is then opened and the peritoneum reached. When the incisions are made into the infiltrated areas much of the fluid of course escapes.

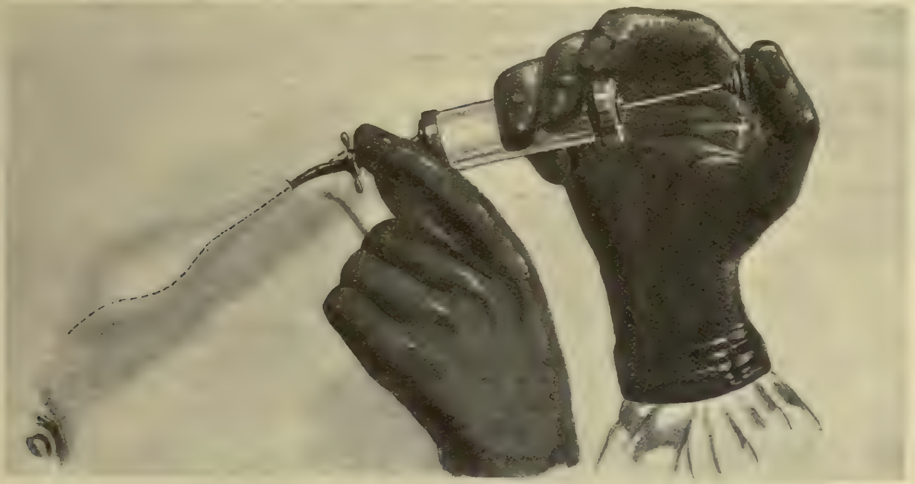


Fig. 108.—Local anaesthesia.
Infiltrating the subcutaneous tissues.

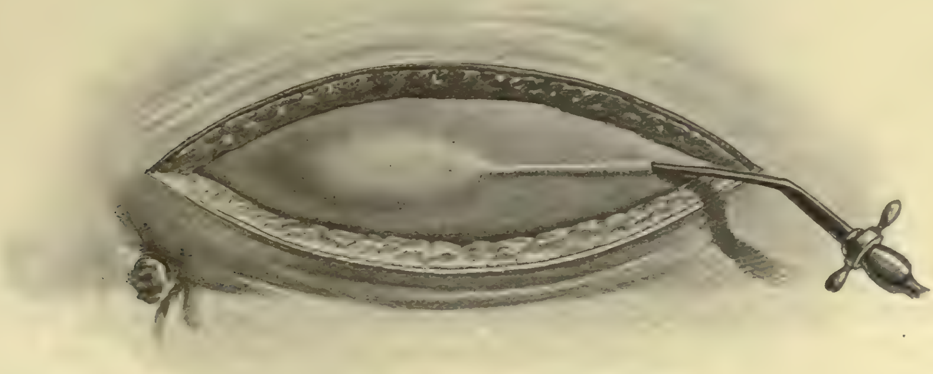


Fig. 109.—Local anaesthesia.
Infiltrating the subaponeurotic tissues.

The infiltration of the subperitoneal cellular tissue, to which Crile attaches great importance, is the most difficult step. The writer's practice is to open the peritoneum sufficiently to admit two fingers, and then, with these fingers inside, to guide the needle along the desired strata on each side of the wound (Fig. 110). In thin persons the amount of subperitoneal cellular tissue is so small that infiltration is very difficult; the solution must then be injected into the deep surface of the rectus muscle through which the nerve-twigs pass to the parietal peritoneum. In doing this, however, vessels of some size may be pricked, giving rise to troublesome bleeding, and great care in haemostasis is called for, or a subaponeurotic haematoma will be formed during convalescence. In fat persons this stage does not present so much difficulty. Crile advocates the use of quinine-urea hydrochloride solution at the end of the operation for the subperitoneal stratum, on the ground that the anaesthetic effect will last for several days, and result in considerable diminution of post-operative pain. In the writer's experience the results are almost as good if novocain alone is used throughout, and as quinine-urea is more toxic in its local action than novocain, there is no good reason for making use of it.

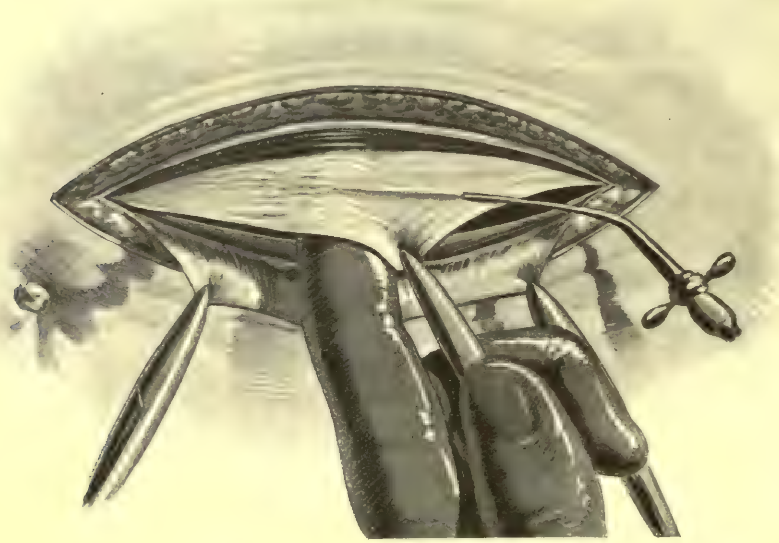


Fig. 110.—Local anaesthesia.
Infiltrating the subperitoneal tissues.

In operations for the removal of the uterus or the uterine adnexa, the broad ligaments and the utero-sacral folds may be infiltrated in the same manner before these parts are clamped or divided (Fig. 111).

The *immediate advantages* of combining local anaesthesia with general anaesthesia are two, (*a*) complete relaxation of the parietal muscles, chiefly of the recti, is obtained at once, and (*b*) the quantity of inhalation-anaesthetic required is reduced to about one-third of the average. Under inhalation-anaesthesia alone the early stages of the operation are often much embarrassed by muscular rigidity and deep breathing; and, until the patient has been some time under the anaesthetic, relaxation does not occur. This difficulty can be entirely avoided by Crile's method. With regard to the general anaesthetic, Crile himself employs a mixture of nitrous oxide and oxygen, which has the great advantage of being practically innocuous. Very large quantities of these gases are, however, required for a long operation, and the cost becomes prohibitive, at any rate in hospital work. In point of fact chloroform or ether can be quite well used instead, and as has been said, the amount needed is very small as only the lightest general anaesthesia is required.

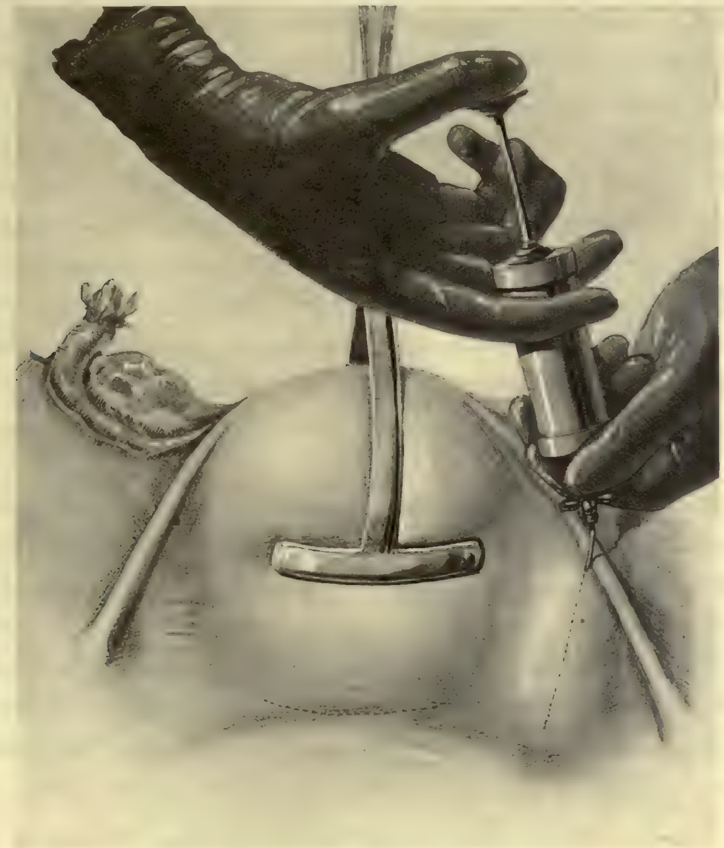


Fig. 111.—Local anaesthesia.
Infiltrating the anterior aspect of the broad ligament.

The *remote advantages* are that there is a surprising diminution of shock, and a decided alleviation of the nausea and pain which often make the first two or three days after the operation so distressing to the patient.

It must, however, be recollected that by *anoci-association* Crile means more than the combined use of local and general anaesthetics. It is a complete system in which the preparation of the patient, the insurance of mental tranquillity, and the exercise of the greatest manipulative gentleness are further points of great importance. It is unfair to claim failure or success for anoci-association unless this method has been tested in its entirety.

Two *disadvantages* must, in fairness, be mentioned. Firstly, the injections and additional time required for haemostasis add ten minutes to the length of the operation. Some of this time is, however, regained in the increased facility of work which is allowed by the muscular relaxation already mentioned. Secondly, the infiltrated tissues do not heal well ; accumulations of serous fluid are apt to occur, especially in the deeper parts of the wound, and healing is thus considerably prolonged. And further, unless great care in haemostasis is exercised, a haematoma may form during convalescence. In the writer's experience there has been no increased liability to suppuration.

It must be admitted that faulty healing of the wound discounts greatly the undoubted advantages of Crile's method. If normal saline solution is used instead of plain water, the difficulty is diminished but by no means obviated. In the case of an obese patient with a thick layer of subcutaneous fat a fine rubber-drain should be laid along the floor of the wound, after closing the peritoneum, and brought out at a separate skin-stab at the side of the lower end of the incision. It can be removed in forty-eight hours, and does not interfere with the solidity of the cicatrix.

General Conduct of the Operation

A point which should always be carried in the surgeon's mind is that more than one abdominal lesion may be present at the same time ; and not uncommonly such lesions are quite independent of one another. When the peritoneal cavity has been opened in order to deal with some pelvic condition, the opportunity should not be lost of examining carefully the commoner situations in which abdominal disease, unconnected with the genitalia, may be found. Appendicitis is very frequent in women of all ages, and in those over forty cancer of the large intestine is also fairly common. Accordingly, when the main operation has been completed the vermiform appendix and caecum, the gall-bladder, and the pelvic colon and upper part of the rectum should always be examined carefully by sight or touch. This is imperatively called for when operations are undertaken for conditions in which pain is a prominent symptom ; pelvic inflammatory conditions must not be accepted as necessarily the sole cause, until careful search in other parts has failed to reveal anything else. It is better to make these explorations a routine part of the operation, otherwise, on occasions, the surgeon will have cause bitterly to repent his omission, when the patient, after an interval, develops acute appendicitis or intestinal obstruction from cancerous stricture. Such cases must have frequently come to the knowledge of the majority of experienced operators. The practice of American gynaecologists is to remove the appendix in practically all cases in which the abdomen has been opened for any purpose ; in this country we usually remove it only when signs of disease, it may be of the slightest, are present. The time spent in this examination is very brief, and nothing is added to the risk of the operation except when infective conditions are being dealt with ; the exploration should then be confined to the pelvis, and the dangerous upper abdominal zone be left alone.

During the actual performance of an operation there are certain broad principles upon which we should endeavour to base our work, and which are of equal importance in the simplest and in the most complex procedures.

1. Importance of Haemostasis.—During an abdominal operation bleeding should be carefully controlled at each succeeding stage of the work. The number of bleeding points encountered in the abdominal wall varies greatly ; in intraperitoneal inflammation they are usually numerous. Vessels of size, whether venous or arterial, should be ligatured; the others may be simply crushed with artery forceps or twisted. The writer's practice is to tie nearly everything ; vessels surrounded by adipose tissue do not twist well, the supporting fat being too friable, and unless tied oozing may occur after the wound has been sewn up. In tying these little vessels the bleeding points should be picked up with as little surrounding tissue as possible, for fat is of low vitality and may necrose when strangulated in bulk by a ligature. Fine catgut is the material of choice for these vessels.

In securing the *ovarian* vessels when dividing the outer part of the broad ligament the same general principles should be observed. Ligature of the broad ligament *en masse* by a stout ligature passed through its centre and tied on each side of the ovary, has been abandoned by modern surgeons. Such a ligated mass of tissue shrinks from escape of serous fluid, and haemorrhage, due to slipping of the ligature, is usually accounted for in this way. The broad ligament should be tied in sections, heed being paid to the simple anatomical fact that the vessels run in its margins—the ovarian vessels in the outer margin, the uterine and the anastomotic vessels in the uterine border. Crushing is a valuable aid to haemostasis in the case of thick structures, such as a chronically inflamed broad ligament; therefore the ligament may be seized in sections and crushed in strong artery forceps or clamps before being divided. The mouths of the vessels may then be picked up and tied separately before the clamp is removed; the crushed stratum being afterwards sewn over with a catgut ligature, or, each crushed and divided section may be separately tied off when the forceps is removed.

Another form of ligature in section is the 'mattress' suture. It is often used for closing broad-ligament cavities, and for controlling a troublesome area of oozing. It is efficient and easily applied, but is open to the objection that it strangulates large masses of tissue. Its use should accordingly be limited to circumstances of difficulty in which haemostasis cannot be secured otherwise.

During deep dissection in the pelvic floor, troublesome venous haemorrhage may be encountered; the walls of the veins lying in friable cellular or adipose tissue are very readily torn, and are sometimes difficult to secure. As far as possible, this form of bleeding should be anticipated and prevented, by securing the uterine artery and the collecting branches of the uterine veins as near the pelvic wall as possible, before beginning the deeper parts of the dissection. In some cases it may be advisable to expose the anterior division of the internal iliac artery or the internal iliac artery itself and ligate it in its continuity.

The value of firm compression in arresting general venous oozing should not be forgotten; the space from which the bleeding comes may be packed tightly with swabs wrung out of hot sterile saline, and compression kept up steadily for two or three minutes, when the oozing may be found to be under control. Occasionally continuous compression by the method of Mickuliz must be resorted to, but modern technique looks with scant favour upon any departure from the principle that intraperitoneal bleeding should be effectively controlled by ligature.

Careful control of haemorrhage during an operation, by conserving blood, diminishes shock, helps to maintain the body-heat, and preserves the powers of the tissues to resist microbic invasion. Next to asepsis it is the first concern of the surgeon when operating, and time expended with this object is time well spent.

The apparatus for intra-venous transfusion should never be absent from the surgeon's armamentarium. A sharp unexpected haemorrhage may very rapidly reduce a debilitated patient to extremes, and the prompt application of intravenous transfusion may be required. The recent revival of direct arterio-venous transfusion, and the excellent results obtained by it must not be overlooked. The technique, which requires practice, has been already described in another Article (Vol. I. p. 549). The giver of blood must be a person in robust health.

2. Healthy Tissues must be protected from Injury and from Infection.—Next to cleanliness the chief surgical virtue is *gentleness*, and this term must be given a wide significance. Not only in rough handling may injury be done to abdominal organs. The vitality of the delicate peritoneal coat of the viscera is depressed by cooling and by drying of the surface. As far as possible only the organs actually dealt with should be allowed to leave the cover of the abdominal walls. At times this is impracticable, and all eventrated structures should then be carefully protected by being covered completely with hot cloths wrung out of warm sterile saline, and frequently renewed as the coverings cool. The peritoneum will not stand a temperature of more than 105° F. without injury, and the use of too hot solutions must be carefully avoided. On the other hand the temperature of the operating theatre should not be allowed to fall below 70° F., or rapid cooling will occur. Chemical irritants, such as carbolic acid, mercuric chloride, and other antiseptics, destroy the peritoneum even more effectively than heat and cold, and they should therefore never be employed. There is, in fact, no necessity for their use, because undamaged peritoneum has the power of disposing of a certain amount of infective material by absorption with much greater certainty than it can be destroyed by an antiseptic solution. If no accumulation of infective material is allowed to remain, it is better not to attempt to disinfect the peritoneal surface; efficient disinfection is impracticable, and partial disinfection will only result in damaging the biological protective function of the peritoneum.

The great importance of avoiding injury to the intra-abdominal organs must not lead us to overlook the necessity of preserving, at the same time, the vitality and cleanliness of the parietal incision. The possibility of injury from the prolonged use of a rigid retractor has been already referred to. Cooling and drying are more difficult to avoid than in the case of the abdominal viscera, but fortunately they do less harm. In dealing with pelvic infective conditions the edges of the abdominal wound should be carefully protected from contamination, as a parietal abscess will form during convalescence. For this purpose the rubber collar shown in position in Figure 90 is very useful (Oldfield). It fits the edges of the wound and overlaps both the cutaneous and peritoneal surfaces. The light lead retractors shown in this figure are used to keep the collar in apposition with the wound-surfaces. In dealing with infective conditions, after the peritoneum has been closed the wound may be swabbed out with normal saline, or with a weak solution of mercuric chloride (1 in 4000). Muscular and fascial structures are less easily injured by chemical irritants than peritoneum, and the germicidal solutions may be fairly made use of here.

Further, we must not overlook the means which may be adopted to combat the *general effects of traumatism* during an operation. Cooling of the body generally may be lessened by maintaining the temperature of the operating theatre, by avoiding undue exposure of the body, or wetting of the skin with solutions, and by keeping the operating table artificially warmed. Shock and haemorrhage produce cerebral anaemia, and from this point of view the inclined position is advantageous, as causing a mechanical determination of blood to the brain. In prolonged operations upon feeble subjects the use of continuous, subcutaneous saline transfusion during the operation is practised by some surgeons. It is questionable, however, whether this is of much advantage during shock; in this condition the blood-pressure is so low that the normal interchanges between the fluid in the capillaries and the plasma in the connective-tissue spaces are undoubtedly disturbed, and it is quite possible that very little of the transfused fluid reaches the blood-stream. After a severe haemorrhage, intra-venous saline transfusion, or arterio-arterial blood transfusion, should be practised.

In this connection it is well to repeat what has been said on an earlier page, that rapidity of work, consistent with gentleness and strict attention to detail, is invaluable in diminishing the severity of the general effects of an abdominal operation.

Isolation of Areas of Infection.—Abdominal operations which involve evacuation of pus, the removal of suppurating organs, or the opening of infected mucous canals, such as the intestine, the vagina, or the gall-bladder, are attended with special risks of operative infection, and call for special care in technique. Isolation of the infected areas during the operation, carefully carried out, will reduce to a minimum the risk of peritoneal infection, and the technique is a matter well deserving of careful attention.

In cases of *pelvic suppuration* the abdominal cavity must be carefully protected. In the majority of cases of pyosalpinx the pus is sterile at the time they come to operation. In recent cases this is not so, and also pockets of pus are not uncommonly encountered in separating adhesions around an acute pyosalpinx; both these and the tubal contents are infective. As soon as the abdomen is opened, and the existence of extensive matting of omentum and intestinal coils above the pelvic organs is seen, the upper abdomen should be packed off before the separation of the adhesions is begun. In addition to the usual large swabs and gauze rolls, an impermeable material may be used in such cases, through which the infective fluids cannot soak. A convenient form of waterproof packer can be made by enclosing a square or oblong piece of thin mackintosh or batiste cloth in a covering of two layers of gauze; packers of this kind can be prepared in two or three convenient sizes and sterilized by steam along with the other swabs and dressings. They are pliable, not bulky, and quite smooth on the surface, and can be used for isolating either the whole or any part of the peritoneal pelvic cavity. The writer first saw them used in the clinique of Harold J. Stiles of Edinburgh. The pieces of mackintosh can be used repeatedly if the gauze coverings are renewed after each operation.

In dealing with cases of acute pelvic inflammation the Trendelenberg position should not be used until the pus has been found and got rid of, lest some of it make its way towards the diaphragm.

When the vaginal canal is to be laid open, as in panhysterectomy, packers should be used to cover the bladder, the pouch of Douglas, and the lateral areas of cellular tissue; the edges of the abdominal wound may also with advantage be similarly protected. In intestinal and appendix operations they are also of great service. Until the infected canals which have been laid open are again closed, the packers are retained in position, and contamination of the surrounding healthy tissues can then be entirely avoided.

Peritonization.—Areas normally covered with peritoneum which have been laid bare during operation should be again covered by stitching peritoneum over them before the abdomen is closed; this is known as peritonization, and its aim is to maintain the unbroken continuity of the peritoneal membrane. After removal of the uterine appendages the peritoneal edges should be sewn together with fine catgut over the stump; when the latter is thickened from inflammatory changes, the round ligament can often be drawn over it and made use of to form a peritoneal covering. These precautions are unnecessary when the divided tissues are healthy, but in inflammatory conditions they should always be taken.

When close adhesions which do not allow of cutting have been dealt with by tearing, raw oozing areas of considerable size are often left. These should if possible be covered up, but in some situations it is very difficult to find slack peritoneum which can be drawn over them. In the utero-vesical pouch the peritoneum covering the bladder and the round ligaments can be made use of. In the region of the left broad ligament appendices epiploice or the pelvic colon itself can often be utilized. At the back of the uterus and the right broad ligament the difficulty is greatest, for here no redundant peritoneum is available. Resort may then be had to *omental grafts*, for if areas of considerable size are left uncovered adhesions will inevitably form, and coils of small intestine falling into the pelvis may become so firmly attached as to give rise to intestinal obstruction.

Omental Grafts.—The omentum is a structure which has the power of rapidly developing adventitious extensions of its vascular anastomoses. This is well seen in the case of uterine or ovarian tumours becoming inflamed or degenerated; they acquire omental adhesions which become very vascular, and should the tumour become detached from the parent organ, the omental blood-supply may suffice for its continued existence. This property of the omentum may be utilized in grafting it upon surfaces which have lost their peritoneal covering.

An omental graft is made by separating a piece of the great or gastro-colic omentum and stitching it over the raw area. An omentum loaded with fat is unsuitable, for fatty tissue is of low vitality; the thinner the omentum the more suitable it is for grafting. The size of the piece should be considerably larger than the area to be covered in order to allow for shrinkage, and it should be carefully handled so that its endothelial covering may not be injured. It should be wiped free of blood, laid smoothly over the raw area, and retained in position by a few fine stitches inserted into the edges of the graft.

3. Drainage.—Certain considerations have now to be referred to which are important from the point of view of the progress after operation. No wound will heal smoothly in which fluid accumulates, or in which necrotic material, or tissues on the point of undergoing necrosis, have been allowed to remain.

To keep a healing wound absolutely dry is impossible, for a certain amount of serous oozing is inevitable. Small quantities can be disposed of by re-absorption, but if large amounts of fluid are subsequently produced they must be allowed free vent; these considerations apply equally to the parietal wound and to the intra-peritoneal wounds. Upon the subject of haemostasis no more need be said, but the question of drainage in abdominal operations is one which deserves careful consideration. We must consider both the circumstances under which drainage is advisable, and the method to be employed.

(*a*) *Peritoneal Drainage.*—The normal peritoneum has a remarkable power of absorbing sterile fluids of low specific gravity; this power may be turned to serviceable ends by pouring a quantity of warm, normal saline solution, from one to two pints, into the peritoneal cavity immediately before closing the wound. Being rapidly absorbed, it assists the circulation and promotes recovery from post-operative shock. The absorptive function of the peritoneum is probably stimulated by the presence of such a fluid, and thus the natural mechanism for the removal of heterogeneous fluids, *i.e. peritoneal drainage*, is assisted. It must be understood that this only applies to the healthy peritoneum. When damaged by injury, inflammation, or other kinds of disease, the peritoneum becomes a *secreting* and not an *absorbing* membrane, *i.e.* its function is reversed. Herein lies the importance of avoiding all operative injury to this delicate structure. Pouring fluid into an inflamed peritoneal sac aggravates an existing derangement of function, and further, incurs the risk of carrying floating particles of infective material into regions as yet free from infection.

The realization of the absorptive function of the healthy peritoneum has led to the disappearance of what, at one time, formed an important step in an abdominal operation, viz. the 'peritoneal toilet.' The custom of surgeons was to remove with meticulous care every drop of fluid that could be found in any part of the peritoneal sac, a proceeding which involved assiduous rubbing of the serous membrane with swabs. There is no doubt that injury was thus often inflicted which actually defeated the end in view, in addition to wasting valuable time and increasing shock. Irrigation of the whole peritoneal sac, by distending it with a large quantity of fluid, was also often practised as the first step in the peritoneal toilet; the disadvantages of this procedure have just been pointed out.

Abdominal surgery is now carefully feeling its way in the direction of limiting the indications for peritoneal drainage. Localized intraperitoneal infections were at one time regarded as necessarily requiring drainage; experience has shown that in such cases, when the area of peritonitis is restricted and the general peritoneum is healthy, the wound may be completely closed, and the peritoneum left to work out its own recovery, which it can do when the original infective focus has been completely eradicated. In many of the chronic suppurative conditions of the pelvis with which the gynaecologist has to deal, the pus has become sterile, and the risk is therefore minimized. In acute suppurative conditions of the pelvis the area of peritonitis is usually too extended to allow of drainage being eliminated, but in the practice of most gynaecologists this is now regarded as the main indication for drainage.

In acute general peritonitis surgical opinion is crystallizing in favour of completely closing the abdomen, or in the alternative, of draining the pelvis only, as being the position in which fluid in bulk is most likely to accumulate. The operative treatment of this condition should be confined to the discovery, and if practicable, the removal of the infective focus to which it was originally due. Most surgeons habitually drain the peritoneum after operations for intestinal anastomosis, and for removal of the gall-bladder. The risk of defective union of the bowel in the former, and the difficulty of isolating the upper end of the gall-duct in the latter are the reasons which justify this precaution.

In rare instances it may be advisable to drain in non-infective lesions, the indication then being the impossibility of obtaining complete haemostasis. The condition in which this difficulty is most likely to be encountered is the enucleation of broad-ligament tumours, a bed being left from which oozing cannot easily be controlled by ligature. Occasionally also the same difficulty arises in connection with recent adhesions to the back of the broad ligaments and the pouch of Douglas, or more rarely the utero-vesical pouch. Flooding the oozing area with warm sterile saline is a useful haemostatic measure, or temporary compression with hot wet swabs will often succeed. If these measures fail an outlet must be provided for the blood which may be effused after the abdomen has been closed ; blood in the peritoneal cavity is dead, and experience shows that it is not easily dealt with by the peritoneum. Further, owing to its suitability as a nutritive medium it is specially liable to become the seat of infection either from the bowel through adhesions, or from bacteria present at the time of operation. Drainage must therefore be provided to allow of its escape. Oozing will not continue for more than forty-eight hours, and the drain can then be removed. It is obvious that the pouch of Douglas and the broad ligament can be most conveniently drained into the vagina.

The advantage of *posture* as an aid to drainage must not be overlooked. In the dorsal position the most dependent parts of the peritoneal sac are the pouch of Douglas and the renal fossae ; into these positions fluids accordingly tend to gravitate. Recent observations have made it clear that the results of infection of the upper part of the peritoneal sac are infinitely more serious than those of infection of the pelvis ; this follows from the free lymphatic communications of the diaphragmatic peritoneum, in which, according to experimental data, the absorptive power of the peritoneum chiefly resides. General septicaemia therefore is much more to be feared when infection reaches the upper abdominal zone. The aim of the surgeon in dealing with an infective lesion of the lower abdomen is therefore to avoid all risk of transmitting the infective material into the dangerous upper zone. This leads him to pack away carefully the intestines and omentum while operating in the inclined position, and after operation he endeavours, by keeping the patient in a semi-sitting position, to gain the assistance of gravity in keeping the dangerous zone clear. The advantage of this position was first emphasized by Fowler in a valuable contribution to the question of abdominal drainage, and it is now generally known as ‘ Fowler’s position.’ When brought in from the operating room, the patient can usually be placed at once in bed propped up into a half-reclining position with pillows. A bolster placed under the flexed knees and tied on each side to the head of the bed prevents her from slipping down again. This position may be maintained for three or four days until it becomes clear that the risk of peritoneal infection has been avoided. When post-operative shock is marked, the recumbent position must be retained for some hours until the condition of the patient has improved.

One of the reasons which have led to the disuse of drainage is the growing appreciation of the difficulties of effectively draining the peritoneal sac. The peritoneal fossae, where fluids are liable to accumulate, can be directly reached by a drain, but owing to the numerous intestinal coils it is obvious that large areas of peritoneum must always remain shut off from any apertures of exit that may be provided. Again, the rapid development of plastic peritonitis around a drain further limits the area from which fluid can escape through it. Within twelve hours the track of the drain is effectively shut off, so that only the small area of peritoneum with which it is in actual contact is in reality drained. Except in strictly localized inflammations drainage is therefore in point of fact impracticable, and then only for a very brief time after operation, amounting in all to a few hours. As Marshall has pointed out, the presence of a drain is, however, of service in quite another manner ; as a foreign body its presence excites plastic peritonitis, which has the effect of materially assisting in the isolation of the infected area from the rest of the peritoneal cavity. A small area of necrotic or infected tissue which cannot be completely removed, or a localized accumulation of infected fluid, is accordingly the condition in which drainage is most likely to be effective and really serviceable ; in diffused infections it is of little service.

There are one or two sufficiently obvious *disadvantages* of drainage which must be mentioned. An open track permits of the entrance of atmospheric and cutaneous organisms into the depths of the wound, and may then convert a non-infective into an infective condition, or a simple into a mixed infection. This no doubt occurs in all cases where the drain is left open for several days. In the second place, the aperture unavoidably gives rise to a weak place in the scar which, in the case of the abdominal wall, may ultimately result in the formation of a scar-hernia. It is not, however, necessary in all cases to drain through the abdominal incision ; a small stab-wound in the linea semilunaris may be made use of, and the abdominal incision closed completely. Each lateral half of the pelvis can be very well drained in this manner through a lateral stab.

Methods of Drainage.—We must now consider (1) the *position* of the drain, and (2) the *material* to be employed.

1. Gynaecological work is most frequently concerned with drainage of the pelvic cavity ; this may be attempted by two routes—the *suprapubic* route and the *vaginal* route. When the latter is used, an opening is made from the posterior vaginal fornix into the floor of the pouch of Douglas or into the broad ligaments ; in this

position the drain track is the shortest possible and it drains the part of the peritoneal sac which in the semi-upright position is the most dependent. When vaginal drainage is combined with Fowler's position, the physical conditions are undoubtedly the most favourable that can be devised. The rapid isolation of the drain by plastic peritonitis, however, renders these advantages more apparent than real. In the case of the suprapubic drain the escaping fluids must flow upwards in order to escape, but the tension of the abdominal muscles and the action of the diaphragm in respiration provide a *vis a tergo* which readily overcomes the slight opposition of the force of gravity. And further, fluid accumulating in the deeper parts of an abdominal drain track can be removed from time to time by aspiration with a syringe, or soaked up with a narrow strip of gauze.

In another important respect the conditions differ widely in abdominal and vaginal drainage. Neither the skin of the abdominal wall, nor the mucous membrane of the vagina is ever sterile ; but in pelvic inflammatory disease while the abdominal wall is healthy the vaginal canal is invariably infected. Under these conditions we are therefore draining a septic abdominal focus into an infected canal, a procedure which is open to the objection that it greatly favours the occurrence of re-infection or secondary infection of the original lesion. When vaginal drainage is used in non-infective conditions, the vagina may be healthier, but is never sterile, and in consequence infection of the drain track can hardly be avoided. Experience shows that this is not merely a theoretical objection, for when vaginal drainage has been maintained for more than forty-eight hours, putrefactive changes almost always occur, and the discharge becomes offensive.

In the case of a drain discharging upon the skin-surface, the conditions are capable of much more effective control than in the case of an opening into the posterior vaginal fornix. Although cutaneous and atmospheric organisms cannot be excluded from it, they are less pathogenic than those which constitute the bacterial flora of the vagina, and further the skin can be disinfected and the opening protected by dressings from external contamination. In the case of an opening into the vaginal roof this is impracticable. An approach to surface-conditions can, however, be obtained by employing a tube long enough to project slightly beyond the vulva, which allows the discharge to be received into sterile or antiseptic dressings, and avoids accumulation in the vagina. A certain amount of discharge still enters the vaginal canal at the sides of the rubber tube when in a day or two the latter gets loose, so that the risk of upward infection from the vagina, although diminished, is not obviated entirely. An additional advantage of the long tube is that irrigation can be conveniently practised through it if desired.

One clear and indisputable advantage may be claimed for the vaginal route, viz. that it in no way predisposes to the occurrence of hernia. In other respects the *pros* and *cons* of the abdominal and vaginal routes are fairly evenly balanced. The author's practice in infective conditions is to employ the latter when it is desired to drain the pouch of Douglas only ; if the upper part of the pelvic cavity requires drainage the abdominal route is chosen ; in some instances it will clearly be wiser to employ both routes. Broad-ligament cavities may always be drained into the vagina ; in this case the cavity is in cellular tissue and the drain does not become rapidly isolated by peritonitic adhesions ; the drain in this case need not traverse the peritoneal cavity at all, and is very short in length, but if the abdominal route is employed both of the latter advantages are sacrificed.

2. Two *materials* may be employed, viz. gauze and rubber tubing ; the use of glass tubes, introduced by Thomas Keith, and widely practised in former years, has been abandoned by most operators.

A strip of sterile or antiseptic gauze drains by capillary action, and is comparatively non-irritating to the tissues. The meshes of the gauze are, however, too fine for thick fluids such as pus and blood to pass them ; only thin serous fluid can drain through it. After twenty-four hours the meshes of the gauze become blocked by coagulated lymph, and its efficacy as a drain ceases ; the gauze must therefore be regularly renewed if its use is prolonged. When covered up with dressings, the heat of the body dries the part of the gauze in contact with the surface, and the drain is thus blocked. Gauze drains must therefore be covered with a wet dressing protected by rubber sheeting, and frequently renewed.

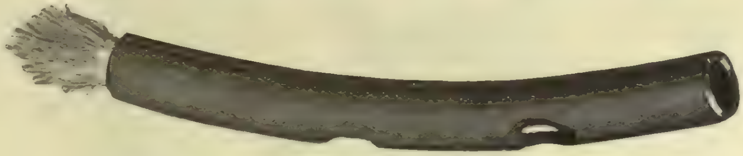


FIG. 112.—Rubber drain with gauze wick.

A distinction must be drawn between the use of gauze for *packing* and for *draining*. In the former case the cavity is tightly filled with layer upon layer of the gauze, the object being to arrest bleeding. Drainage through gauze packing is of course very imperfect. Compression is antagonistic to free drainage, and must be carefully avoided when gauze is used for the latter purpose.

Rubber tubing drains more freely than gauze, but as already mentioned fluids tend to stagnate in the deeper parts of the tube. This difficulty may be overcome by introducing a slender strip of gauze into the tube, which provides capillary action as well. In preparing this drain a piece of tube of appropriate size is taken, and two or three small side openings are made into it. It is then split from end to end, opened out, and the gauze wick placed inside it (Fig. 112). The wick should not be longer than the tube, or the projecting end will dry up under the dressings and block the drain; if the end does not project it will remain soaked with the discharge and the capillary action will continue. The gauze wick can be withdrawn and renewed without disturbing the tube at all. This is probably the best form of abdominal drain, but is not suitable for the vagina, as the gauze wick cannot be conveniently changed. A full-sized rubber tube attached by a catgut stitch to the edge of the opening in the posterior fornix forms the best vaginal drain.

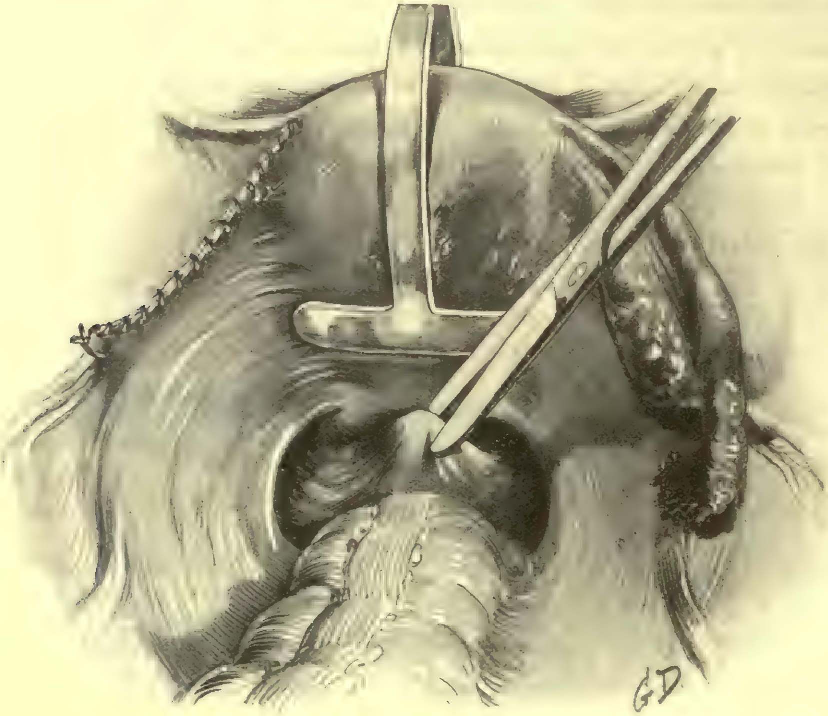


Fig. 113.—Vaginal drainage.
Cutting down on the point of the forceps.

Another form of gauze and rubber drain is that known as the 'cigarette drain.' It is made by placing upon a square piece of waterproof a similar piece of gauze of somewhat smaller size; the two are then loosely rolled up together from one edge, until a drain of appropriate thickness has been formed. It is less irritating than rubber tubing, and drains much more efficiently than gauze alone. It is suitable for intra-abdominal drainage only.

When vaginal drainage is employed in an abdominal operation, it is usual to open the posterior fornix from above; this can be readily done if a long curved pair of forceps (Fig. 113) is passed into the vagina by an assistant, carried up the posterior wall and pushed firmly upwards behind the cervix. The point can be seen or felt from above, and the vaginal wall cut through upon it, the opening being enlarged by pushing the blades of the forceps through and then opening them. If a rubber tube is employed, the lower end is grasped and pulled through the vagina to the vulva; the upper end should be attached by a catgut stitch to the edge of the opening in the vaginal wall, or to the back of the uterus. Instead of a rubber tube a strip of gauze may be used, the lower end being pulled into the vagina.

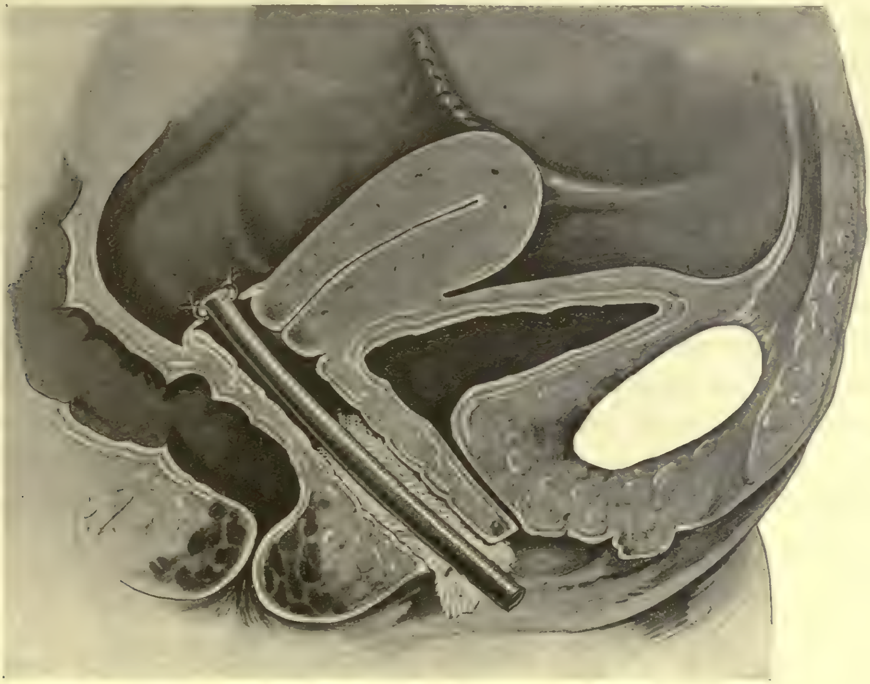


FIG. 114.—Vaginal drainage.
The tube is stitched to the edges of the opening in the posterior fornix.

Efficient preparation of the vagina for drainage is difficult to secure. In cases of pelvic inflammation, where the canal is probably infected, and where vaginal drainage may be necessary, the vaginal walls should be thoroughly swabbed under anaesthesia with tincture of iodine before the abdomen is opened. This should also be done in all cases before commencing the operation of panhysterectomy.

(*b*) *Wound-Drainage.*—Incisions into healthy tissues usually heal perfectly without drainage, and drainage of the abdominal wound is seldom practised. If the incision is made in the linea alba, below the umbilicus, it is never necessary. When the transverse incision or the paramedian incision is used considerable separation of the aponeurosis from the underlying muscle occurs, oozing of blood is free, and during the process of healing serous exudation, or in some cases a haematoma, may form. If the anoci-association anaesthesia of Crile is practised with these incisions the tendency to oozing of blood and to severe exudation is even greater. The best way to secure complete union of the wound under these circumstances is to drain it. In the case of a longitudinal incision a fine piece of drainage tube is laid in the subperitoneal tissue and brought out of the lower angle of the wound, the aponeurosis and superficial layers being brought together over it. In the case of the transverse incision the drain must be placed upon the recti muscles and the aponeurosis closed over it, the end being brought out at one of the lateral angles. For three or four days a free blood-stained discharge occurs; the tube can then be withdrawn, when the track will rapidly close without suppuration and without appreciably weakening the cicatrix.

Incisions through infected tissues must always be freely drained. When infective conditions have been dealt with *per abdomen*, and it is intended to close the abdominal wound, the surface should be lightly wiped with a swab squeezed out of tincture of iodine after the peritoneal edges have been united. A fine rubber drain is then laid on the floor of the wound, the effect of the iodine being to cause free serous oozing for several days subsequently.

The Closure and Protection of the Wound

Before proceeding to close the abdominal wound the surgeon must see that careful count is made of the swabs and instruments which have been in use during the operation; a responsible person, such as the second assistant or the theatre sister, should alone be entrusted with this duty.

The general principle that an abdominal incision should be closed in layers and not in bulk is now universally accepted, and needs no discussion. The importance of suturing in layers as a preventive of post-operative hernia, has been placed beyond doubt by universal experience. The alternative method of closing the incision by stitches which embrace all the layers and pass from the skin to the peritoneum, not only yields a weaker cicatrix but is open to objection on the ground of imperfect asepsis. Such stitches must be made of unabsorbable material or they would not be sufficiently resistant. They then act as setons during the process of healing, for along the track of the suture, cutaneous organisms may pass into the deeper parts of the wound or even into the peritoneal cavity. If suppuration occurs in the wound, spread of the infection to the peritoneum along the suture tracks is unavoidable.

In restoring the planes of the abdominal parietes four points must be borne in mind: (*a*) oozing should be efficiently controlled; (*b*) dead spaces in which fluid may accumulate should be obliterated; (*c*) buried stitches should not strangulate thick masses of tissue, but should unite edges only; (*d*) all fluid should be squeezed out of the deep parts of the wound before the last stitches of each plane are tied. Unless injury has been inflicted upon the tissues by forcible retraction of the edges of the wound during the operation, or unless they become infected, firm and durable union can always be secured by attention to these points.

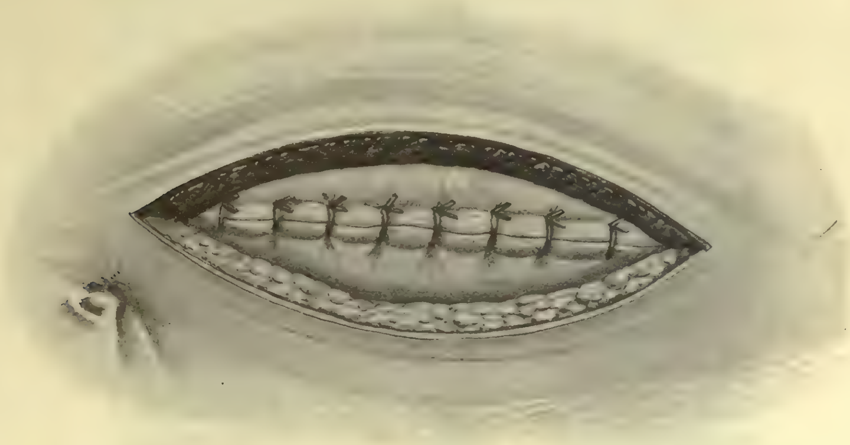


Fig. 115.—Closure of the abdominal wound. Interrupted stitches for the aponeurosis.

The suture material of choice for buried stitches in the abdominal wall is undoubtedly catgut. The general principle that an absorbable material should be used has been accepted by all but a few surgeons. The minority, however, includes such distinguished names as Kocher and Bland-Sutton. It cannot be denied that unabsorbable stitches, if sterile, may be buried in the tissues without harm resulting, and as long as their sterility is maintained they may so remain indefinitely. They are, however, foreign bodies, and therefore sources of potential if not of actual irritation, and experience shows that they may give rise to suppuration many months and even years after their introduction. It is claimed that silk or thread are more readily sterilized, and in use are therefore safer than catgut, and that more durable union is obtained by their use. To the great majority of surgeons the advantages of securing union without burying ‘ splints ’ in the abdominal wall are so obvious as to call for no elaborate justification.

A second point upon which individual choice is freely exercised is whether the buried stitches should be continuous or interrupted. When non-absorbable material is used the buried suture should never be continuous, for if infection should occur in any part of the wound the removal of the infected suture involves opening up the entire wound, while if it is not removed the infection will follow the track of the suture from one end to the other. The objection that a continuous suture causes more strangulation of tissue than interrupted stitches is sound and also deserves consideration. Yet the running stitch has advantages, for it is rapidly introduced, and approximates the edges more uniformly than interrupted stitches can possibly do. In one important respect interrupted stitches offer greater security

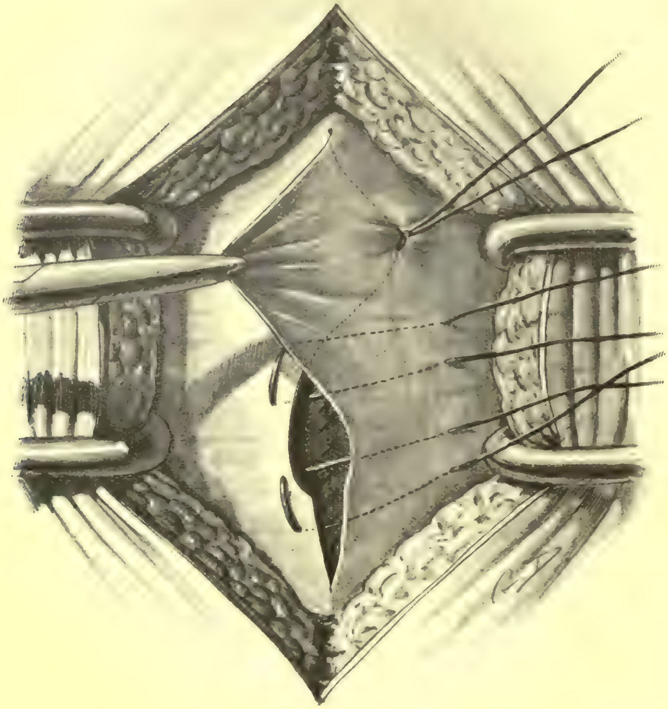


Fig. 116.—Duplication of the aponeurosis. First stage. (After Kelly and Noble.)

than a continuous one, for if the latter is defective at one point, the whole wound will give way, while with interrupted stitches the failure of one is of less importance. The author's practice is to use a continuous stitch for the peritoneum—a non-vascular membrane in which strangulation is of little consequence, and interrupted stitches for muscle and aponeurosis. Interrupted stitches should be placed at one-third of an inch intervals. Overlapping imbricated stitches may be used for the aponeurosis when this is atrophied and over-stretched as in multiparae with deficient muscular nutrition. A simple form of overlapping stitch is that shown in Figs. 116 and 117; the effect is to duplicate the aponeurosis along a band about an inch broad beneath the skin cicatrix.

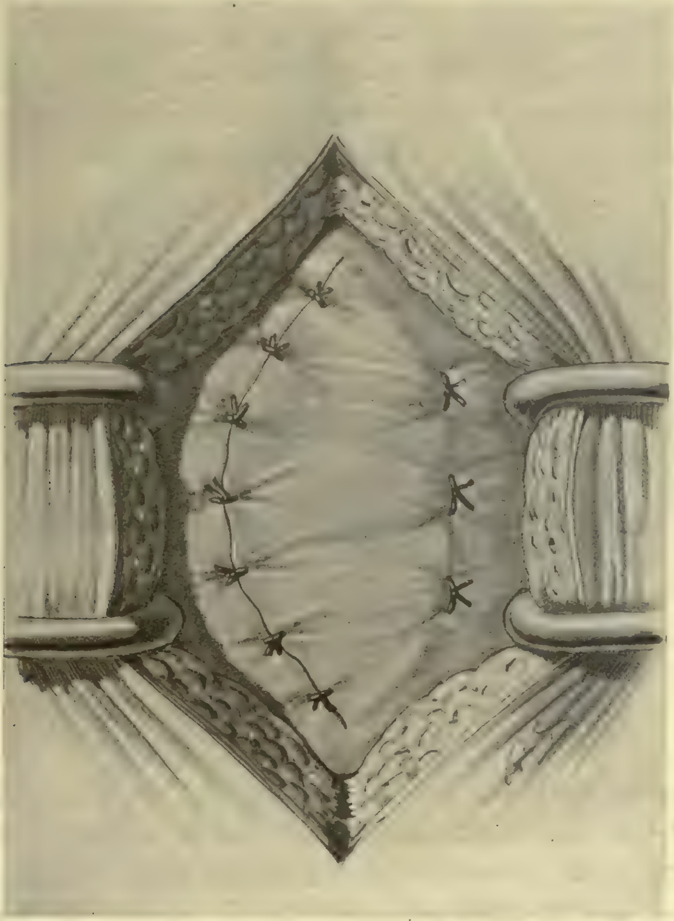


Fig. 117.—Duplication of the aponeurosis. Second stage. (After Kelly and Noble.)

Many different methods of closing the skin-wound are practised. If the subcutaneous fat is abundant this should be drawn together independently with interrupted stitches of fine catgut. Fatty tissue is of low vitality and stitches of unabsorbable material are unsuitable for implantation in it.

Accurate union of the skin-edges is a point of some importance for upon it depend rapid healing and the sightliness of the scar. In covered parts of the body the latter is not of great importance; the strength of the cicatrix is of much greater moment than its appearance. Whatever method of stitching is employed the edges must be in accurate contact and without dragging. Each point on one edge must be brought up to the exactly corresponding point upon the edge opposite, and in sewing up an incision several inches long there is abundant room for error. Assistance may be gained by making a series of parallel superficial skin-scratches with a strong needle across the line of the wound before the first cut is made. In sewing up, these scratches form fixed points which can be accurately brought together (Fig. 138, p. 407); as an alternative the ends of the incision may be picked up with Kocher's forceps, and the skin put gently on the stretch; the edges at the mid-point of the wound can then be similarly picked up and the forceps left on while the sewing-up proceeds.

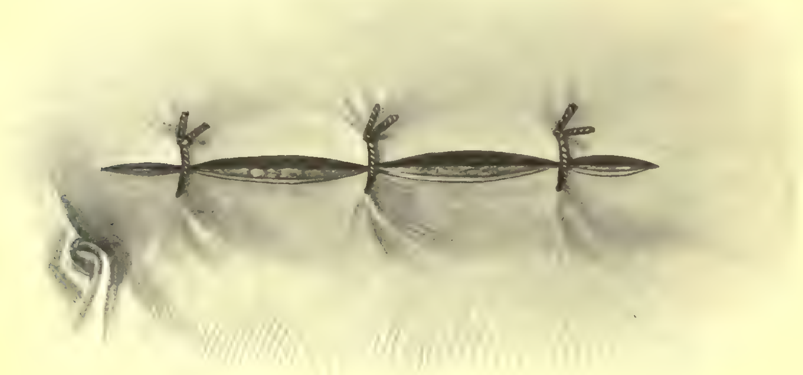


Fig. 118.—Closing the skin incision.
Three deep sutures have been passed and tied.

There are three different methods of skin-closure which may be made use of in an abdominal wound, viz. interrupted stitches, a continuous suture, including the subcuticular stitch, and metal clips.

The interrupted sutures have the advantage of allowing the escape of a certain amount of serous exudation between the suture points; when the edges adhere the wound is of course sealed, but until this occurs a certain amount of drainage is possible. In a long wound three of these stitches can be passed deeply beneath the aponeurosis so as to hold all the superficial strata of the wound firmly together. Unabsorbable material is usually employed for interrupted skin stitches but stout catgut may be used if preferred.

Of the running or continuous stitch there are several different kinds which are sufficiently illustrated in the accompanying diagrams (Fig. 119). The subcuticular stitch is the only one which presents difficulty in technique. The suture must be entered at each step immediately beneath the cuticle, otherwise fragments of subcutaneous fats will be forced upwards between the cuticular edges as the stitch is pulled tight. This suture yields a scar which becomes almost invisible in time, and as the skin is not pierced at all, the cicatrices of needle-punctures are entirely absent. The disadvantage is that it is insecure, and may give way from strain during vomiting or retching, and it tightly locks up all secretions in the wound. A fine suture of thread or silk is usually employed, which becomes loosened in the tissues during the second week, and can be easily withdrawn. Fine catgut may be used instead, but it must be recollected that this material is very rapidly absorbed.

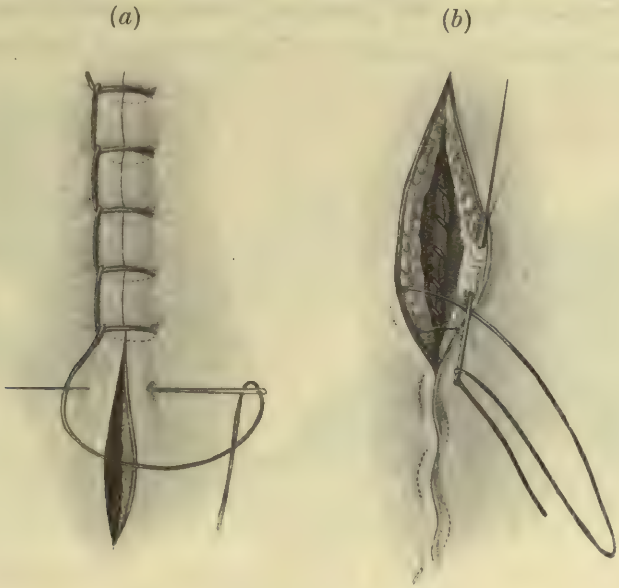


Fig. 119.—Methods of skin-suture.
(a) Blanket stitch; (b) subcuticular stitch.

The metal clips introduced by Michel allow of more rapid closure of the skin-incision than any other method. The punctures made by these leave scars quite as prominent as needle-punctures but they leave a fine linear cicatrix which is hardly visible after a time. They are removed on the fifth day. Like the subcuticular stitch they are comparatively insecure, and may give way from strain; it is therefore useful to supplement them with two or three interrupted stitches embracing the tissues down to but not including the aponeurosis.

There are two natural hindrances to the healing of wounds in or near the middle line of the abdominal wall: one is that the muscular and cutaneous fibres being arranged transversely, the normal pull of the tissue strains the stitches and tends to open the wound; the other is that when a thick fat layer exists, and when considerable dissection of muscle has been practised, serous exudation occurs, which may seriously prejudice the healing process. The first-named difficulty is inherent in the method and cannot be obviated. The latter can be avoided by draining the wound or by continuous compression.

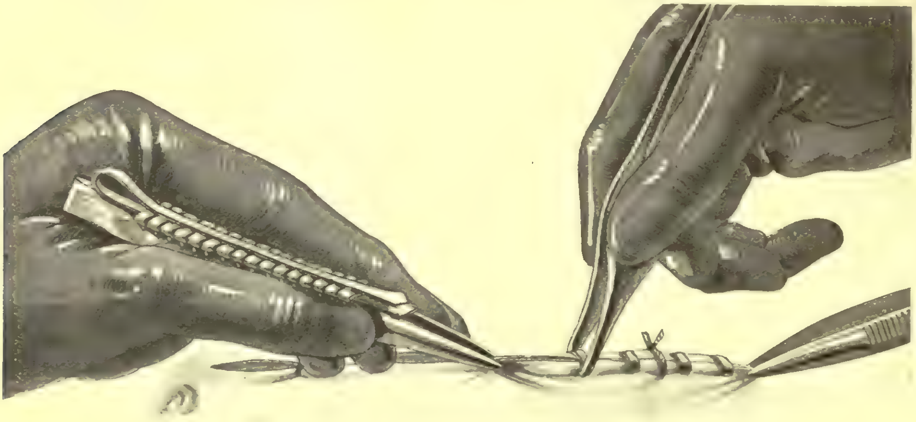


FIG. 120.—Introducing Michel's clips.

Compression may be applied to the wound by fixing a firmly-rolled gauze roll over the whole length of the wound. Three or four interrupted stitches of stout thread or of silkworm-gut are introduced. As soon as the peritoneum is closed, they pass through skin, subcutaneous fat, aponeurosis, and muscle, and are left untied till the aponeurosis and the skin have been sutured. A firm roll of gauze, about 1 inch thick and 5 to 6 inches long, is then laid upon the wound, and the stitches tied over it. This brings together the parietal layers, compresses them against the roll, and at the same time protects the surface of the wound from exposure. The stitches securing the roll may be removed on the fourth day.

Protection. The treatment of the abdominal wound when closed completely is a matter of little importance, for equally good results may be obtained by the most divergent methods. Iodine may be applied to the wound as soon as the skin-sutures have been introduced. Some surgeons cover the wound first with a collodion dressing, then with layers of sterilized gauze, then with cotton wool, and finally a tight bandage or an abdominal binder of the many-tailed variety is applied. Other surgeons in addition fix strips of adhesive plaster over the first layers of the dressing to give further support to the wound. At the other extreme lies the practice of those surgeons who paint the wound with iodine and then leave it entirely exposed, the only after-treatment being to repeat the iodine application every day. It has been repeatedly shown that healthy skin-wounds, healing by first intention, contain numerous bacteria, and accordingly no attempt need be made to maintain strict asepsis, *i.e.* to destroy the skin-organisms, during convalescence. It is, however, a matter of importance to prevent the access of bacteria from without, and a dressing which will keep clothing and bed-linen from actual contact with the wound is a surgical desideratum. Further, the absence of an abdominal binder greatly increases the distress caused by the act of vomiting, and throws the whole strain of retching upon the wound-stitches. After the fourth day wound-coverings are unimportant when healing is proceeding normally, for adhesion of the skin-edges is then complete, and organisms from without can no longer enter.

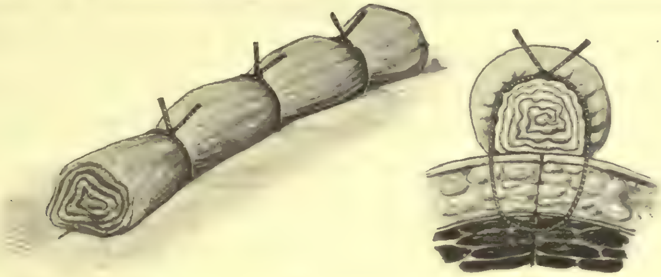


FIG. 121.—Wound closed and protected by a roll of gauze held by deep stitches. The holding-stitches should be passed through the whole thickness of the muscle.

When drainage is employed the most careful aseptic treatment of the wound is of course called for. The escaping fluids should be received upon layers of cyanide gauze packed around the tube; although this material has no germicidal power when dry, as it becomes soaked in the discharge the mercuric salt is dissolved and the antiseptic action begun. Over the antiseptic dressing layers of sterile gauze and wool are placed, and held in position by a binder.

Wounds of the *vagina* and *vulva* are much more difficult to protect during healing than those of the abdominal wall. The impracticability of completely disinfecting these parts before operation has been already referred to, and fortunately, healing in these tissues may proceed favourably in the presence of the abundant non-pathogenic bacteria which are normally present. At the same time the access of pathogenic organisms from without must be as far as possible prevented, for these will not be tolerated by the healing wound. Vaginal wounds need no direct treatment, as a rule, but the vulva must be kept scrupulously clean and covered with a sterile dressing ; if there is appreciable oozing or leucorrhoeal discharge, a simple vaginal douche of boric acid or weak peroxide of hydrogen should be given daily to prevent stagnation in the vagina. Under special circumstances it may be desirable to expose the wound with a Sims' speculum and swab the line of stitches daily with iodine.

Perineal wounds should be treated in the simplest manner possible. Here again the organisms normally inhabiting this region cannot be excluded, it is the introduction of bacteria from without which is to be feared. In changing the dressings the nurse should use sterilized forceps, and the neighbourhood of the wound should be kept clean by squeezing warm lotion over it. The best treatment for a perineal wound is a dry dressing for the first forty-eight hours until oozing has ceased, and then a mild antiseptic ointment, such as 1 in 40 boric acid or 1 in 40 carbolic acid, made up to soft consistence with vaseline. These ointments must be re-sterilized daily before use by boiling the pot in an ordinary sterilizer. The oily application protects the healing surfaces from urinary and leucorrhoeal contamination, and greatly diminishes the discomforts attending wounds in this position.

ANAESTHETICS

By FELIX ROOD, M.B.
(London)

GENERAL ANAESTHESIA

Chloroform.—Chloroform may be administered by the open method from a piece of lint or a folded towel, or by means of a special inhaler. The percentage of chloroform vapour in the inspired air which is necessary to produce anaesthesia is small, varying from 2 to 5 per cent. Some inhalers, of which the best known are the English Vernon Harcourt, the French Dubois, and the German Roth Dragen, deliver definite percentages of chloroform with more or less accuracy.

By whatever method chloroform is given, certain principles must be observed. The induction must be continuous and progressive, the strength of chloroform vapour being gradually increased. This is easily achieved by a regulating inhaler. If the open method is adopted sufficient accuracy can be obtained by gradually lowering the mask to the face and increasing the amount of chloroform dropped upon it. When anaesthesia is complete the amount of chloroform may be reduced, less anaesthetic being required to maintain anaesthesia than to establish it.

The production of anaesthesia by chloroform is generally described in stages for convenience. Clinically a period of muscular spasm may be recognized which gradually gives place to muscular relaxation. The respiration is a reliable guide to the patient's condition throughout anaesthesia.

The accompanying diagram (Fig. 122) shows a typical respiration-tracing during induction of anaesthesia. For considerations of space the tracing is much contracted, only about 1 respiration in every 10 being reproduced. The tracing shows very well the slight irregularity of respiration due to nervousness at the commencement of the induction, followed by more regular breathing as the higher centres gradually come under the influence of the drug. The periods of muscular spasm shown by the irregular respirations are quite typical. This condition is slowly replaced by more regular breathing with slight phonation during expiration. Finally the respiration becomes regular and automatic when anaesthesia is complete.

Considerable difference of opinion exists in regard to the exact method of inducing anaesthesia with chloroform. Some observers maintain that the percentage of chloroform should be small and very gradually increased, and that, if given by the open method, the chloroform should be withdrawn during struggling and respiratory spasm. Others, on the contrary, hold that the chloroform should never be withdrawn during struggling, and that it should be rapidly increased in strength, so that complete anaesthesia is quickly obtained. The balance of evidence available at the present time appears to favour the latter view. The induction is well known to be the most dangerous period of chloroform anaesthesia. We all know the sudden pallor of the face, the rapid irregular pulse, the dilated pupils, and gasping inspiration that mark the ‘ syncopal ’ attack.

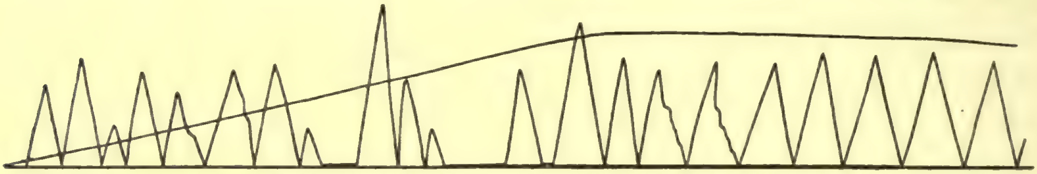


Fig. 122.—Respiration-tracing during induction of anaesthesia by chloroform.

The excellent work of Goodman Levy[1] throws considerable light upon this subject. He points out that these so-called ‘ syncopal ’ attacks are really due to ventricular fibrillation which only occurs during light anaesthesia. Fatalities frequently happen during the early stage of anaesthesia before enough chloroform has been absorbed to produce an overdose. These observations confirm and to some extent explain the clinical experience of those who assert that these dangerous syncopal symptoms do not occur if the induction is rapid, continuous, and progressive.

The line superimposed upon the respiration-curve in the tracing indicates the progressive dose of chloroform maintained in spite of the irregular respiration.

The signs of complete chloroform anaesthesia are—regular automatic respiration, muscular relaxation, and loss of reflexes, together with certain appearances in the eyes, *e.g.* fixed globes and moderately contracted pupils which react to light. When anaesthesia is satisfactorily established the respiration should be regular in depth and frequency, and the pulse regular in force and rhythm.

[1] *Heart*, vol. iv.

Chloroform may be given by—

(1) *Open Methods.*—Apparatus generally employed: a piece of folded lint; a wire or metal frame covered with lint or gauze (Fig. 127).

(2) *Closed Methods.*—Using instruments which yield definite percentages of chloroform. These are of two kinds, the plenum (Roth Dragen) and the vacuum (Vernon Harcourt).

In the former a mixture of chloroform and air or oxygen is delivered to the patient in a continuous stream. In the latter a closely fitting face-piece is used, and at each inspiration air is drawn through the apparatus and over the surface of chloroform contained in a special reservoir.

(3) The Junker's inhaler. In this apparatus air is pumped by a hand bellows through chloroform contained in a bottle. The instrument is really a plenum inhaler in miniature. This apparatus is generally used in connection with a metal mouth-tube for giving chloroform for operations about the mouth and jaws. In these cases the operator would be embarrassed by the presence of a face-piece.

Ether.—Anaesthesia may be produced with ether by—

(1) Inhalation either from an inhaler or by the open method.

(2) Insufflation into the trachea with a special apparatus.

(3) Absorption from the colon.

(4) Intravenous infusion.

A high percentage of ether vapour must be inhaled in order to produce anaesthesia, and the various devices by means of which it is administered depend upon this fact. A number of ingenious inhalers are at present on the market; they are easy to manipulate, produce anaesthesia rapidly and comfortably, and undoubtedly have much to recommend them, but they all involve breathing into a bag, and there are certain objections to this arrangement. A volume of air passes backwards and forwards through the septic cavities of the mouth and nose, and becomes laden with septic matter which is conveyed down to the pulmonary alveoli. Consequently the risk of septic pneumonia is increased. Also there is a certain amount of congestion and asphyxia unless oxygen is also administered continuously.

If ether is given by the open method some arrangement must be made to ensure that the necessary strength of vapour is inhaled. This is best done by making a gauze pad some 15 to 20 layers thick, and fixing it on to the wire frame in the same way as but instead of the usual piece of lint.

Clinically ether produces muscular spasm followed by muscular relaxation; it also stimulates the respiratory centre. If the diagram of the respiration (Fig. 123) during ether-inhalation is compared with that of chloroform certain differences will be noted. The preliminary irregularity due to nervousness is shown; then follow more regular respirations increasing markedly in volume as the drug becomes absorbed by the blood and carried to the respiratory centre. Respiratory spasm is not a feature of the induction with ether. If it does occur, it is due to the mechanical irritation of the larynx by the pungent vapour and can be instantly relieved by lifting the mask for a moment. A slight spasm is indicated in the diagram. The respiration then becomes more regular and frequent, with perhaps a little phonation during expiration. Finally the breathing becomes automatic in character when anaesthesia is completely established.

Ether vapour is very pungent; therefore the induction, especially during the early stages, must be slow. If the strength of vapour is irregularly increased, coughing and laryngeal irritation will be set up, and this causes distress to the patient.

Unlike chloroform, the induction of anaesthesia by ether is not attended with danger.

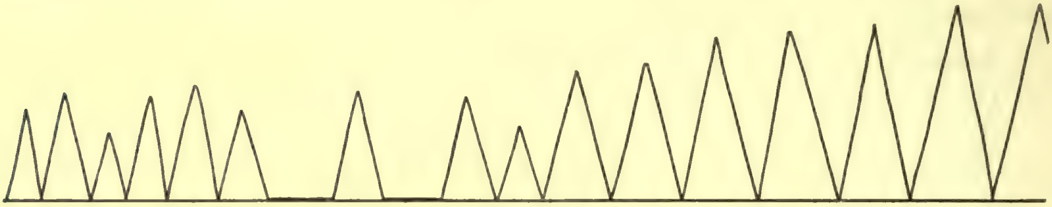


FIG. 123.—Respiration-tracing during induction of anaesthesia by ether.

Ether may be given—

1. By inhalation.
    Open method. *Apparatus*—a wire frame covered with several layers of gauze (Fig. 124).
    Closed method. *Apparatus*—Clover's inhaler and modifications thereof.
2. By intratracheal insufflation.
    A mixture of air and ether vapour is warmed and delivered at a constant pressure through a catheter which is inserted into the trachea.
    Apparatus—(*a*) Kelly's; (*b*) Shipway's.
3. By intravenous infusion of a solution of ether in normal saline.
    Apparatus—Rood's (Fig. 125).
4. By absorption from the colon.
    A mixture of 75 per cent of ether and 25 per cent of olive-oil is introduced into the colon.

Intravenous Ether Infusion.—Ether may be administered intravenously dissolved in saline solution. Ethyl ether is soluble in normal saline solution at

60° F. to the extent of 10·8 per cent by volume, so that a 5 per cent solution may be prepared by dissolving 1 oz. of ether in 1 pint of saline, or a 10 per cent solution by dissolving 2 oz. The method was first adopted by Burghard, who used a 10 per cent solution. He tied a cannula into the median basilic vein and allowed the ether solution to run in until the patient was anaesthetized. A clip was then placed upon the tube connected with the cannula and the flow stopped until the patient showed signs of coming round, when the dose was repeated. There are two objections to this method: in the first place interruption of the flow allows blood to clot in the cannula and so causes obstruction to the flow of ether saline; and in the second place an excess of ether is introduced into the circulation in order to keep the patient under for a time, and when once this dose is given the administration is no longer under control.

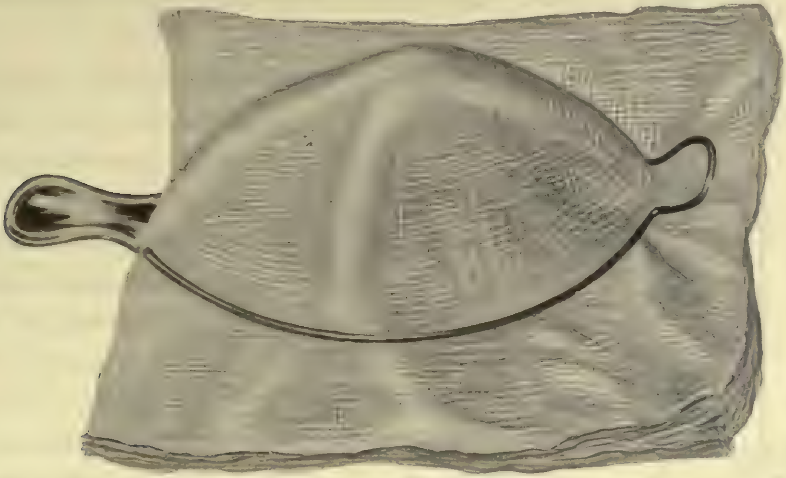


FIG. 124.—Gauze mask for administration of ether by the open method.

Kümmel improved the technique. He used two reservoirs, one containing ether saline and the other normal saline, which were connected by a Y-shaped junction with the cannula so that when the ether solution was stopped the flow of fluid could be continued with normal saline. This arrangement prevented clotting in the cannula but did not obviate the drawbacks to discontinuous dosage.

The apparatus illustrated in Figure 125 was devised by the writer to deliver a continuous stream of ether saline. The amount and rate of the flow can be varied at will. The apparatus is made of glass and consists of three parts: A, the reservoir; B, the dripping or regulating chamber; C, the warming chamber. The reservoir is connected to the dripping chamber by means of a rubber tube which is attached to a cannula passing through a hole in the rubber stopper which closes the upper opening of B. The side opening in B is also closed by a rubber stopper and is only used to facilitate filling the apparatus. At the lower end of B a tap X is fixed. C is merely a warming chamber, and is immersed in a receptacle of hot water. From C a rubber tube leads to a glass cannula which is inserted into the vein.

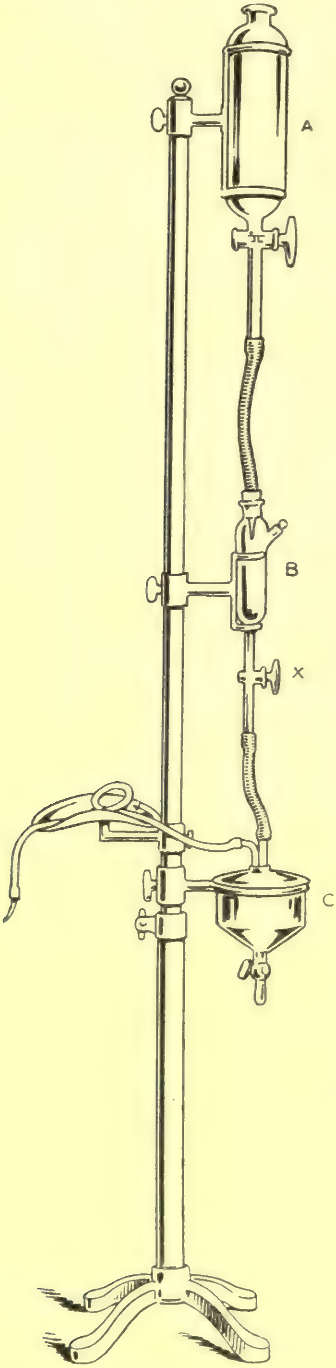


Fig. 125.—Rood's apparatus for the intravenous infusion of ether.

When the apparatus is filled and the tap X opened, fluid will flow from the cannula into the vein. So long as the flow continues fluid will be seen dripping through B. This provides an exact indication of the rate of flow. The rate of flow can be accurately controlled by tap X.

Technique.—A hypodermic injection of atropin should always precede the administration. This may be combined with some hypnotic if the case is a suitable one. The cannula should be inserted into the median basilic or cephalic vein. The internal saphenous at the ankle has been recommended, but if this vein is used it is sometimes difficult to get the fluid to flow. The vein is exposed and the cannula tied in under local anaesthesia with due regard for asepsis.

The tap X is then opened and the ether saline allowed to flow in. Almost immediately the smell of ether can be detected in the patient's breath. Induction is rapid, being generally complete in 3 to 5 minutes; there is usually no struggling or excitement. Complete anaesthesia is accompanied by the usual signs—automatic respiration, muscular relaxation, and loss of reflexes.

When surgical anaesthesia is established, the flow of anaesthetic solution must be reduced and then regulated by means of the tap X, so that a constant degree of anaesthesia is maintained. It will be found in practice that the amount of anaesthetic can generally be reduced as the operation progresses.

Complications.—If great care is not exercised during the little operation of tying the cannula into a vein, the wound is extremely likely to suppurate. This will render the patient liable to all the dangers of septic thrombosis in the vein of the arm. If a 10 per cent solution of ether is employed a transient haemoglobinuria may develop immediately after the anaesthetic. This clears up in the course of a few days. This does not occur if a 7 per cent solution is used. Nausea and vomiting are very rare after this form of anaesthesia.

Indications.—This method of producing anaesthesia is very useful for those cases in which shock is either present or is likely to arise during the operation; such as rupture of a viscus or internal haemorrhage. The writer has had excellent results with the intravenous infusion of ether in cases of chronic intestinal obstruction in which the patients have been in a very frail and emaciated condition beforehand. These patients frequently left the table in an improved general condition after excision of gut or gastro-enterostomy.

Although the ether is administered by the veins, it is of course excreted through the lungs; consequently although much less irritating than ether by inhalation because the concentration is less, nevertheless the method should not be used in the presence of active pulmonary disease unless the operation is one for which spinal or local analgesia is unsuitable.

Nitrous Oxide.—Nitrous oxide gas is generally used for short operations, but need not be limited to such, for it readily maintains anaesthesia so long as the administration is continued. In order to induce anaesthesia satisfactorily nitrous oxide must be inhaled undiluted or mixed with a very small percentage of oxygen. A closely fitting face-piece is used connected with a rubber bag.

If the gas is given alone the patient is deprived of air during induction of anaesthesia and would be asphyxiated if the administration were continuous. In order to avoid this, breaths of air must be given at intervals after anaesthesia is established. Some practice is required to avoid asphyxia and yet maintain an even anaesthesia.

Many forms of apparatus have been devised and are used for giving nitrous oxide combined with small percentages of oxygen. Of course this gets rid of the asphyxial troubles entirely, and gas with oxygen often does produce excellent anaesthesia. Crile strongly advocates this combination together with anoci-association as a routine anaesthetic for major surgery. Oxygen occasionally produces excitement during induction of anaesthesia; nausea and vomiting are not very infrequent sequelae.

When giving gas the mask should fit the face closely and the bag should be only partly filled. After a few breaths of gas the respirations become deeper, more rapid, and continue gradually to increase in volume until the breathing becomes stertorous in character. If the administration is continued beyond this stage without the admission of air, asphyxia rapidly supervenes, and the patient jactitates vigorously. The stop-cock of the apparatus must be turned and a single breath of air admitted directly the respiration becomes stertorous. This will prevent the asphyxial jactitation. Stertor is the most reliable sign of surgical anaesthesia. As anaesthesia progresses, more and more air should be given, and the administrator must endeavour by a judicious management of the air-tap to produce a regular anaesthesia without allowing the patient to become cyanosed. Some patients are very resistant to nitrous oxide gas, so much so that it is occasionally almost impossible to produce anaesthesia.

Nitrous oxide does not produce muscular relaxation, which is an objection to its use for abdominal operations.

Ethyl Chloride.—Ethyl chloride is a convenient drug with which to produce anaesthesia for short operations or as a preliminary to the use of ether. At ordinary pressure and temperature ethyl chloride is a gas, but is supplied by the makers in sealed and graduated glass capsules under slight pressure as a transparent volatile liquid; a spraying nozzle is attached to the tube.

Ethyl chloride is generally given from a special inhaler. Many patterns exist, but the only essentials are a closely fitting face-piece connected with a rubber bag into which the ethyl chloride can be sprayed. Ethyl chloride can be given by a semi-open method—a wire frame covered with several thicknesses of gauze is used, and the anaesthetic sprayed upon it. Ethyl chloride is extraordinarily rapid in action, induction of complete anaesthesia being almost a matter of seconds. Five cubic centimetres is an average dose for an adult, 2, 3, or 4 for children according to age.

Before inducing anaesthesia with an inhaler it is advisable partially to inflate the bag with oxygen, so that the patient may have a medium to respire other than his own expired air. If valves exist on the apparatus they must be adjusted so that the patient breathes to and fro into the bag. Having sprayed the required dose of ethyl chloride into the bag, adjust the face-piece accurately, and direct the patient to breathe quietly. The respiration rapidly becomes automatic and stertorous, the eyeballs become fixed, the pupils dilated, and the conjunctivae insensitive. When this condition is established, the patient is ready for operation.

Ethyl chloride is a very convenient and portable anaesthetic, but this is practically all that can be said in its favour. No type of anaesthesia can be obtained which cannot be equally satisfactorily produced by other means, nor does ethyl chloride possess advantages over other anaesthetics for any special kind of case. The most noteworthy complication is spasm of the respiratory muscles and those of the larynx. Cyanosis appears to predispose to this complication. Syncope may also occur.

The Use of Narcotics.—Many people strongly object to taking an anaesthetic, and nervous patients often find it a very trying ordeal indeed. Fortunately the induction period can now be made less unpleasant than was formerly the case. Patients should not be compelled to walk down to the operating-room and climb on to the table. They generally very much appreciate being anaesthetized in their own room, or in an ante-room attached to the theatre. Moreover, a nervous patient can be better reassured in a quiet room than in a busy theatre.

The various methods by which anaesthesia is induced are arranged to secure as far as possible both the comfort and safety of the patient. Of course any of the general anaesthetics will induce anaesthesia, but some are better adapted for this purpose than others. Ether or nitrous oxide gas is the most satisfactory drug with which to commence an anaesthetic, ethyl chloride is less so, and chloroform is the least satisfactory of all. The induction of anaesthesia may with great advantage be preceded by a hypnotic. A judicious dose of morphia, or morphia and scopolamine will not only allay all the patient's fears, but will often produce a sound sleep, during which the anaesthetic may be administered without awakening.

Ether stimulates the salivary and mucous glands, so much so that the abundant secretion interferes with the proper aeration of the lungs, which are more or less filled with mucus charged with the anaesthetic. Atropin has a special action upon the mucous glands, causing temporary paralysis which prevents this secretion. A patient who has been anaesthetized by ether without a preliminary administration of atropin is generally more or less congested and often very cyanosed indeed, a stream of mucus dribbles from his mouth, and the rattle of the mucus in his bronchi can be heard with a stethoscope, or often by any one standing by his side. If, however, the mucous glands have been paralysed, there will be no asphyxia, and respiration will be quiet and unembarrassed by mucus either in the lungs or pharynx.

A hypodermic injection of atropin should therefore always precede the administration of ether, unless the patient is actually *in extremis*, in which case the amount of ether required will be so small that there will probably not be any excessive secretion. The average dose of atropin is gr. $\frac{1}{100}$. Children tolerate the drug well, and $\frac{1}{150}$ gr. may be given to quite small babies.

The powerful hypnotics, morphia and hyoscin (or scopolamine as it is usually called), must be given before anaesthesia with the same consideration and caution as at all other times. Morphia, apart from its comforting effect, produces during anaesthesia a tranquil respiration which is of great assistance to the abdominal surgeon and renders ether anaesthesia indistinguishable from that of chloroform. Scopolamine is a powerful hypnotic, often producing profound sleep during which the patient can be anaesthetized without being awakened. If morphia and scopolamine are given, less anaesthetic is needed; the after-vomiting is generally less and the patient sleeps for some hours after the operation. Of course morphia must be given to children with the utmost caution and in very small doses. The same applies to scopolamine.

It is inadvisable to give hypnotics to very weakly patients, or to those who are likely to become so during operation, but for an ordinary abdominal operation open ether preceded by scopolamine, morphia, and atropin is a very nearly ideal combination. The patient will probably be fast asleep before operation, will sleep for three or four hours afterwards, and when he does awake will learn with surprise that the operation has been completed. It is most dangerous to administer these powerful drugs as a routine. The patient should be examined beforehand, and the dose and combination decided for each individual case.

The following sequences are commonly employed to produce anaesthesia :

(1) Atropin—open ether.
(2) Atropin, morphia—open ether.
(3) Atropin, morphia, scopolamine—open ether.
(4) (Atropin)—nitrous oxide, ether from an inhaler.
(5) (Atropin)—ethyl chloride, ether from an inhaler.
(6) (Atropin)—ether—chloroform.
(7) Ether and chloroform mixtures—chloroform.
(8) Chloroform.

Ether should always be used for the induction when possible, chloroform only when it is impossible to avoid it. Ether may be given from the commencement by the open method, or may be preceded by nitrous oxide or ethyl chloride, in which case a special apparatus must be employed. Ethyl chloride is popular because it is convenient and portable, but it is not so free from danger as nitrous oxide gas.

If ether is contra-indicated, chloroform must be used for the induction. This drug cannot be used to follow gas or ethyl chloride.

Complications

The complications met with during induction of anaesthesia are :

Ether.—(1) Laryngeal irritation—from coughing to complete spasm ; (2) vomiting ; (3) cyanosis—asphyxia.

Chloroform.—(1) Respiratory spasm ; (2) vomiting ; (3) circulatory disturbances.

From considerations of space only the open method (Figs. 126 and 127) of giving these two drugs will be dealt with in detail. Similar complications are liable to ensue whatever the method of administration, and the same remarks on treatment apply.

Ether.—Induction of anaesthesia with ether by the open method requires some practice before it can be accomplished rapidly and smoothly and without distress to the patient. The secret of success is a regular and progressive induction and the use of plenty of ether. In the opinion of the writer the best method is to soak the mask with as much ether as it will conveniently hold. The patient is directed to breathe gently, and the mask is lowered slowly on to the face (Fig. 126). Laryngeal irritation occurs when the ether vapour has not been increased regularly. Inspiration of a too pungent vapour acts as a mechanical irritant. Generally only coughing occurs, which is instantly relieved by raising the mask for a moment, but if the stimulus was very powerful complete laryngeal spasm may occur, during which the patient ceases to breathe and becomes rigid, in a condition of expiratory spasm. Asphyxia develops and the patient looks alarmingly blue. The ether

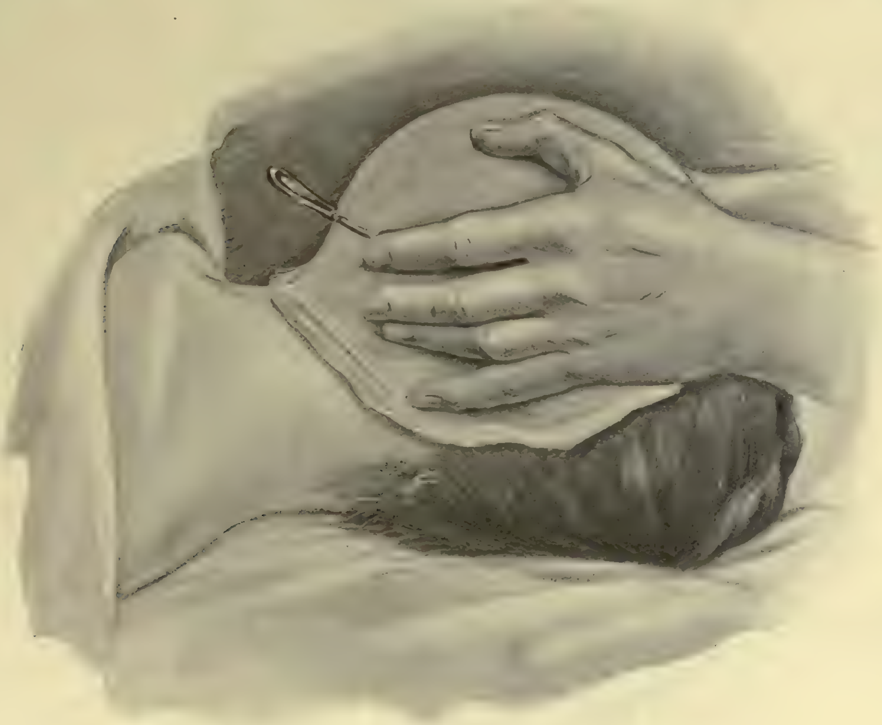


FIG. 126.—Administration of ether. Open method.

mask must be removed. Then a gentle compression of the chest will drive the strong ether vapour out of the larynx and generally relieve the spasm.

Vomiting may occur during the induction if the amount of anaesthetic is not increased regularly. Momentary holding of the breath and swallowing are often premonitory signs of vomiting. Should they occur the respiration must be stimulated by firmly pushing the lower jaw forwards, and more ether must be given, taking care not to produce spasm of the larynx by too sudden increase in the strength of vapour. Should vomiting actually take place, the patient's head

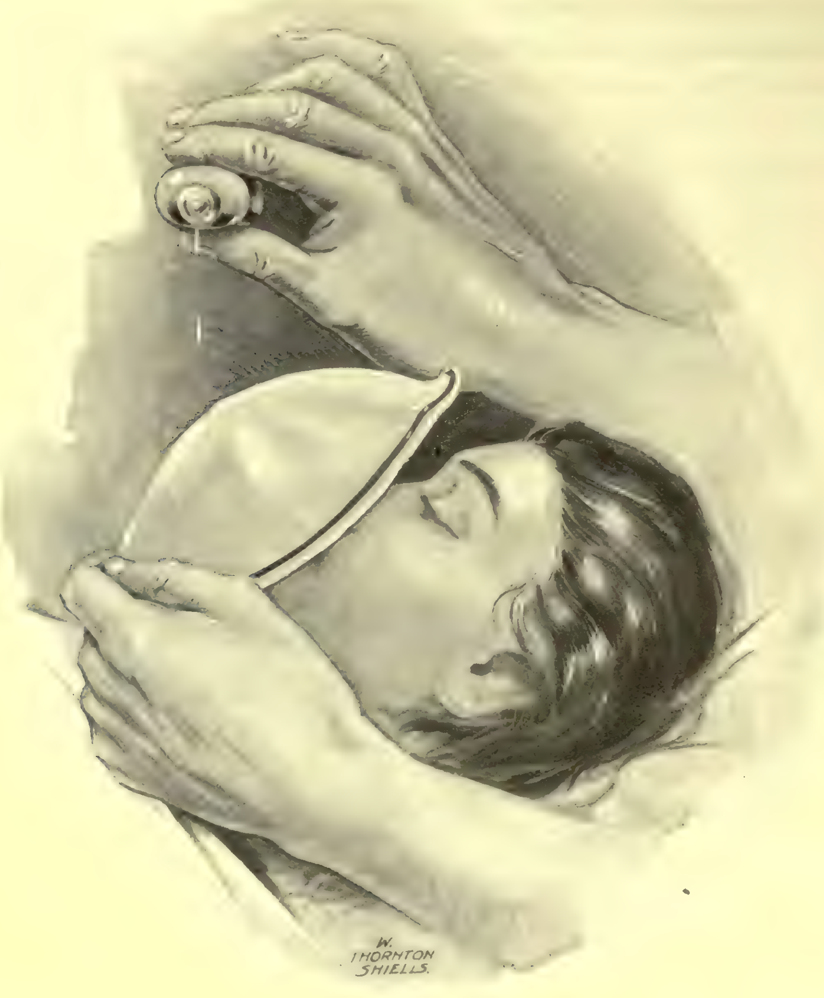

W. THORNTON SHIELLS.

FIG. 127.— Administration of chloroform. Open method.

must be turned to one side and all vomited matter cleared from the mouth and pharynx before proceeding with the induction.

Cyanosis is due either to an obstruction in the air-passages, or to a limitation in the supply of air by some form of closed ether inhaler. The respiratory passages may be obstructed above the glottis by mucus, by spasm of the jaw-muscles, by falling back of the tongue, and by congestion and swelling of the tongue and aryteno-epiglottidean folds of mucous membrane; in the larynx by spasm, and below the larynx by mucus. An unobstructed respiration is essential to good and safe anaesthesia and must be maintained at all costs.

Cyanosis occurring during induction is generally due to muscular spasm producing rigidity of the jaw-muscles, and congestion which mechanically obstructs the opening of the larynx. Sometimes it is possible to relieve this condition by altering the position of the patient's head, which may allow the tongue to fall away from the glottis, but generally it will be found necessary to open the mouth with a gag and draw forward the tongue.

Obstruction in the larynx is due to spasm. The treatment of this complication has been considered above. If the cyanosis is due to the accumulation of quantities of mucus in the lungs, oxygen must be given. Cyanosis should be treated by oxygen only when the obstruction causing it cannot be removed, as in the case of pulmonary diseases or mucus in the bronchi.

Chloroform.—*Respiratory spasm* is only a part of a general muscular spasm which is a feature of the action of this drug. Usually no treatment is necessary as the spasm relaxes without interference.

Vomiting may occur during induction with chloroform in exactly the same way as with ether and from the same cause, *e.g.* the induction has not been regularly progressive. The treatment is to establish a free air-way and increase the chloroform.

The *circulatory disturbances* which are liable to occur during the production of anaesthesia with chloroform are the most serious complications of anaesthesia. Until recently little was known of the nature of these symptoms which were variously described as "syncope," "cardiac syncope," etc. The work of Levy has lately thrown considerable light upon the mode of production of these phenomena. They are apparently due to a condition of ventricular fibrillation set up only during light and irregular anaesthesia. The clinical features of this condition are a sudden pallor, usually accompanied by gasping inspirations, dilatation of the pupils, and alterations in the pulse varying, according to the severity of the case, from irregularity and rapidity to complete disappearance. This complication of chloroform anaesthesia often terminates fatally, and is the most frequent cause of death during induction before the commencement of the operation.

Owing to the grave nature of this complication induction with chloroform should be avoided if possible. The evidence available at the present time suggests that the complication is best avoided by a rapid and regular induction. It is useless to increase the chloroform if once the symptoms appear, but at the first sign of gasping inspiration combined with pallor the head should be lowered and oxygen given. If, in spite of this, respiration fails it must be continued by artificial means. In those cases which recover the pupils will gradually contract, the colour and pulse will return, and finally respiration will be re-established. There is no evidence that hypodermic injections of strychnine, ether, etc., are of the least use in this condition; indeed it is more than probable that they are actually harmful.

Maintenance of Anaesthesia

Anaesthesia must be thoroughly established before the operation is commenced, otherwise reflex stimulation of the larynx may cause respiratory obstruction and consequent difficulty, if not danger, throughout the entire administration. The nausea and vomiting which sometimes follow anaesthesia are generally proportional in severity to the amount of anaesthetic absorbed. Hence when once anaesthesia is fully established, the smallest quantity of the drug should be given which will satisfactorily maintain anaesthesia and meet the requirements of the operation.

The difficulties likely to arise during anaesthesia are very similar with both ether and chloroform, *e.g.*—

(1) The anaesthesia may become too deep.

(2) The anaesthesia may become too light.

(3) The air-way may become obstructed.

(4) Complications connected with the operation may arise, such as shock and collapse.

The usual signs of an *overdose* of anaesthetic are slow shallow respirations, cyanosis, and a rapid pulse, very feeble in the case of chloroform. If ether is the anaesthetic employed, respiration generally ceases before any signs of cardiac failure appear. If the condition is recognized before respiration stops, the anaesthetic must of course be withdrawn until a safe degree of anaesthesia is again established. If the breathing actually ceases, however, artificial respiration must be resorted to. It is well to remember that a simple overdose of anaesthetic is rarely fatal, and anything in the nature of a panic during efforts at restoration should be avoided.

The mouth must be opened and the tongue drawn forwards before commencing artificial respiration, so that the air-passages are unobstructed. Artificial respiration is then carried out slowly and quietly, and oxygen is administered at the same time. The hypodermic injection of stimulants, strychnine, etc., only momentarily raises the blood-pressure and does not appear to be of any value in these cases.

If too little anaesthetic is given the patient will pass back into the induction stage and become liable to all the complications of that state.

Obstruction in the air-passage is the most common complication of anaesthesia, and most of the difficulties of the beginner are due to this cause. An excellent illustration of this fact is provided by those cases in which laryngotomy and tracheotomy have been performed as a preliminary to some severe operation about the mouth or pharynx. A clear air-way is maintained mechanically and complications hardly ever occur.

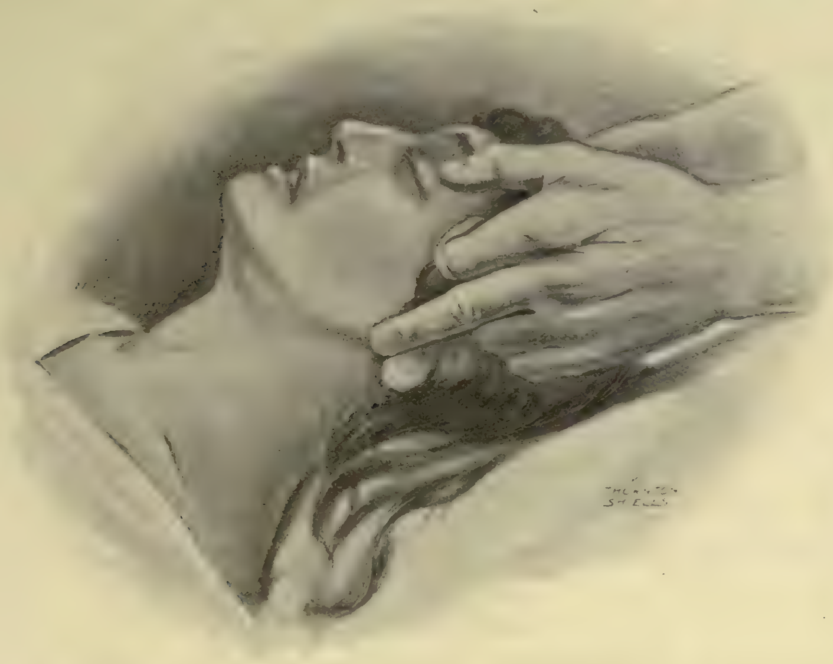


FIG. 128.—Method of supporting lower jaw behind the angle to obtain free air-way.

Obstruction may be due to—

(1) Nasal obstruction.

(2) Falling back of the tongue and jaw.

(3) Congestion and swelling of the tongue and the aryteno-epiglottic fold, combined with spasm of the jaw-muscles.

(4) Laryngeal spasm.

(5) Mucus in the bronchi and lungs.

Obstruction to respiration during ether anaesthesia causes a gradually increasing cyanosis, whilst during chloroform anaesthesia cyanosis, or pallor, or a combination of the two may occur.

No general instructions for maintaining a free air-passage can be given. In some cases merely pushing forward the lower jaw will suffice (Fig. 128), in others it may be necessary to separate the teeth with a gag or prop, and to draw forward the tongue by means of a thread passed through it. In the event of complete obstruction in or above the larynx, which persists after all other methods have been tried, tracheotomy or laryngotomy must be performed. If the obstruction is from blood or mucus in the lungs oxygen must be given continuously.

Shock and *collapse* may arise as the result of long-continued or severe surgical operations, or the patient may be in this condition before the operation as the result of accident or disease.

The first manifestation of shock is an increase in the rate of the pulse; the patient then becomes pale and cold. The respirations are at first quickened, but later become slow and sighing in character. As shock develops less anaesthetic should be given, until it is withheld altogether if the shock becomes really severe.

The circulation through the brain must be maintained by lowering the head and raising the legs; the limbs may also be tightly bandaged. If haemorrhage has occurred an intravenous infusion of saline is beneficial, and whatever the cause of the shock great care must be taken to keep the patient warm.

After-Treatment

Patients should not be left unattended when recovering from anaesthetics, as they are liable to certain accidents and complications which, if not properly treated, may become dangerous. Free breathing may be prevented by rigidity of the jaw-muscles, or actually stopped altogether by falling back of the tongue and jaw. Sickness not uncommonly occurs during this stage, and the vomited matter may obstruct respiration or be inspired into the lungs. If morphia and scopolamine have been given, the jaw-muscles sometimes remain lax, and the jaw consequently needs supporting for an hour or more after the operation is finished. But if the amount of anaesthetic is properly reduced as the operation proceeds, the muscular tone will generally have so far returned at its completion that no support to the jaw will be necessary.

Usually by means of a little experiment a favourable position can be found in which the patient breathes quite freely. The best position (Fig. 129) in most cases is obtained by raising the shoulders with pillows, so that the neck is slightly extended at the same time, while the face is turned to one side; of course if the patient is suffering from shock the head must not be raised.

Sometimes it is difficult, if not impossible, to differentiate between the complications which arise as the result of the surgical proceedings and those which are actually due to the anaesthetic.

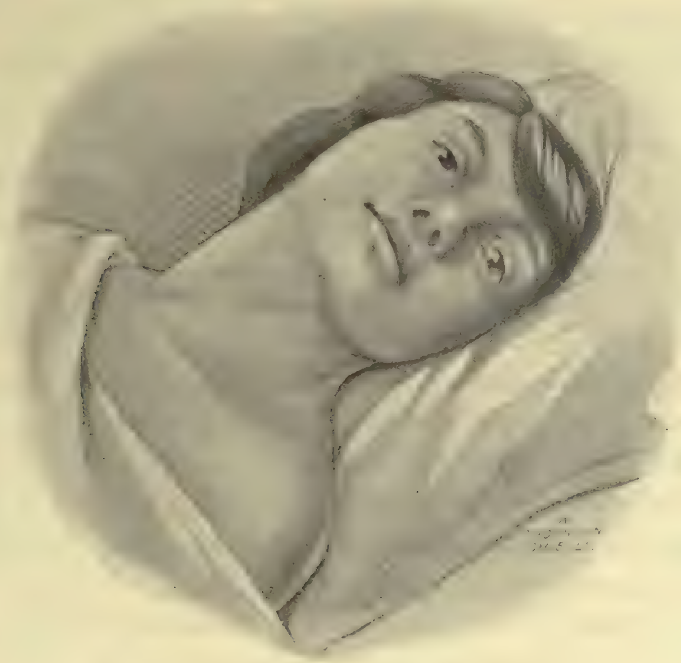


Fig. 129.—Position in bed after anaesthesia.

The pulmonary complications which sometimes follow an anaesthetic may range from a slight and transient bronchitis to septic broncho-pneumonia. Ether is generally supposed to be more prone to produce respiratory complications than is chloroform, but it is doubtful if this is so. Pneumonia and bronchitis are septic conditions and originate from some infection. They commonly follow operations upon septic cases, such as acute appendicitis or osteomyelitis. In those cases of malignant disease in which a foul growth exists in the mouth or pharynx, the danger of septic pneumonia is much increased whatever the anaesthetic employed.

Some Continental clinics use chloroform and others ether as a routine, and a comparison of the results obtained shows that fewer respiratory complications occurred in those institutions using ether. Anything which interferes with free expansion of the lungs predisposes to congestion and pneumonia. For this reason respiratory complications more commonly follow operations upon the upper part of the abdomen—or indeed abdominal operations generally. The wound in the abdominal wall causes spasm and rigidity of many of the muscles of respiration, and consequently inefficient expansion of the chest.

If bronchitis or pneumonia does occur, treatment must be carried out upon ordinary medical lines. As a precaution against these complications all forms of inhaler causing re-breathing from a bag should be avoided. Atropin should be given to prevent the secretion of large quantities of mucus, and any septic conditions of the teeth, mouth, or pharynx should, if possible, be attended to before administering any anaesthetic. The patient's head and shoulders should be raised up on pillows as soon as possible after she is put back to bed.

Nausea and vomiting frequently occur after anaesthesia. The severity of this complication, allowing of course for personal idiosyncrasy, is generally in proportion to the amount of anaesthetic inhaled. Hypnotics given before anaesthesia usually reduce sickness by diminishing the amount of anaesthetic required. Vomiting is unusual after the intravenous infusion of ether. If salivation occurs during the administration, quantities of anaesthetic-sodden mucus enter the stomach, generally causing severe sickness afterwards. Post-anaesthetic vomiting generally follows one of two types :

(1) Beginning immediately after the administration and lasting perhaps twenty-four hours.

(2) The delayed type, usually commencing eighteen hours or more after the administration but persisting for days, and sometimes only terminating with the death of the patient.

The first is the usual type ; the second, when it does occur, generally follows the administration of chloroform.

Ordinary anaesthetic vomiting is best treated by washing out the stomach, and it is only in a few operations upon the mouth, pharynx, oesophagus, and stomach that this is not permissible. The least unpleasant way of obtaining this result is to allow the patient to drink half a pint of warm water, which will immediately be ejected together with any anaesthetic-sodden mucus which may have been retained in the stomach.

Should vomiting persist in spite of the treatment, 1 m. doses of tincture of iodine in water every hour may be tried, or 5 m. of dilute hydrocyanic acid in effervescing mixture.[1]

The most serious but happily rare complication of anaesthesia is a disturbance of metabolism, which is generally regarded as an *acid intoxication.* This condition is more apt to follow the administration of chloroform than of ether. Apparently any septic condition predisposes the patient to this delayed poisoning—so much so that most anaesthetists would hesitate to administer chloroform to such cases as acute appendicitis or osteomyelitis.

The symptoms are late vomiting, generally beginning about thirty hours after the operation and gradually increasing in severity, and in those cases which terminate fatally, convulsions may occur, and finally the patient passes into coma.

In the days before this condition was recognized the writer once gave chloroform to a healthy child of 2½ years in order that an X-ray photograph of a misshapen foot might be taken. The child took the anaesthetic well and recovered consciousness without any untoward incident. The next day vomiting began and persisted until the child finally died in coma on the fourth day after the anaesthetic had been given.

The symptoms of this condition and the characteristic changes in the urine, such as the presence of β-oxybutyric acid and acetone, are similar to those produced by any septic intoxication, but the establishment of post-anaesthetic acidosis as a definite clinical entity is based upon cases such as that quoted above, and also upon the improvement in results which have been observed by various surgeons who have operated upon large numbers of septic cases under spinal or ether anaesthesia instead of chloroform. It is probable that this condition is much more frequent than the fatal cases which are reported from time to time would lead one to suppose. The severe cases of post-chloroform sickness, especially those beginning some time after the anaesthetic and persisting for days, are in all probability lesser degrees of acidosis.

Starvation rapidly produces a condition of acidosis, especially in children. It is therefore unwise, and in most cases not at all necessary, to withhold food for a long period before operation. A rough general rule is that the operation should take place when the next meal is due. Sugar in one form or another has been recommended by many writers as a prophylactic treatment. The ordinary barley-sugar is a convenient form and is much appreciated by children.

Intravenous infusion with a solution of sodium bicarbonate in water, ʒi to Oi, has been recommended as treatment, but the results obtained in the severe cases in which coma has developed have not been very encouraging.

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[1] Anaesthetic vomiting is also considered in the Article on After-Treatment (p. 707).

LOCAL ANALGESIA

Local analgesia can be produced in three ways, *e.g.*:

(1) By infiltration of the whole area of operation with a weak solution of a suitable drug.

(2) By introducing a stronger solution of the drug around the trunks of the nerves supplying the area of operation (regional analgesia).

(3) By introducing the drug into the spinal theca (spinal analgesia).

Many substances when applied to sensory or motor nerves abolish conductivity, but our choice for clinical purposes is limited, because many of the drugs which are excellent analgesics have other actions which are dangerous; *e.g.*, cocaine can never be safely used for infiltration or regional analgesia. It is now generally admitted that novocaine and β-eucaine are the most suitable agents for producing regional and infiltration analgesia, and stovaine for spinal analgesia.

Local Infiltration Analgesia.—A 0·2 per cent solution of β-eucaine or novocaine is employed, and sufficient sodium chloride is added to make the whole isotonic with the blood. This solution may be conveniently prepared from the following formula:

β-eucaine . . .	3 grains.
NaCl	12 grains.
H_2O	3½ oz.

15 m. of adrenalin 1 in 1000 are added to every 3½ oz.

The adrenalin constricts the blood-vessels and prevents the eucaine or novocaine from being too quickly washed away from the area of operation by the blood-stream. Seven or eight ounces of the fluid may be safely used, in fact the success of this form of local analgesia depends upon the use of a large quantity of solution and a very thorough infiltration. The injection of so much fluid causes a temporary oedema of the tissues, and for this reason the infiltration should always be completed half an hour before any operation is commenced if it is necessary to recognize anatomical details. This allows ample time for the oedema to subside.

The apparatus required consists of a syringe and a number of hollow needles of varying length and calibre. The record syringe with glass barrel and metal plunger is a convenient pattern. Detachable needles of all sizes are easily obtainable (Fig. 130).

Technique of Infiltration.—The injection is made with ordinary aseptic precautions. The syringe and needles are sterilized, the analgesic solution boiled, and the patient's skin prepared as for operation. A minute puncture is made into the skin with a fine needle and a few drops of solution injected. The distension of the skin produces a small bleb or weal (Fig. 131) which is quite insensitive. A larger needle is next passed through the analgesic spot, and the deeper tissues infiltrated.

The deep structures should be infiltrated first, then the subcutaneous tissues, and finally the skin. In the case of the abdominal wall a few little blebs are made along the line of incision. A long fine needle is then inserted through these insensitive spots and the peritoneal and subperitoneal tissues are infiltrated, next the muscular layers, then the subcutaneous tissues, and finally the skin. A very fine needle must be used when infiltrating in the neighbourhood of large vessels. It should be detached from the syringe before introduction; then, if by chance a vessel is pricked, blood will immediately appear up the needle which can be withdrawn. No harmful results follow puncture of a vessel by a fine needle. If the needle is attached to the syringe, no blood will appear, and the injection might under these circumstances be made into the lumen of an artery or vein.

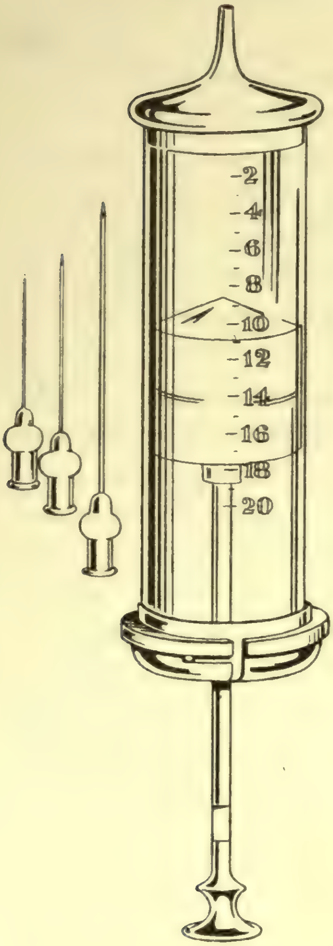

Fig. 130.—Record syringe.

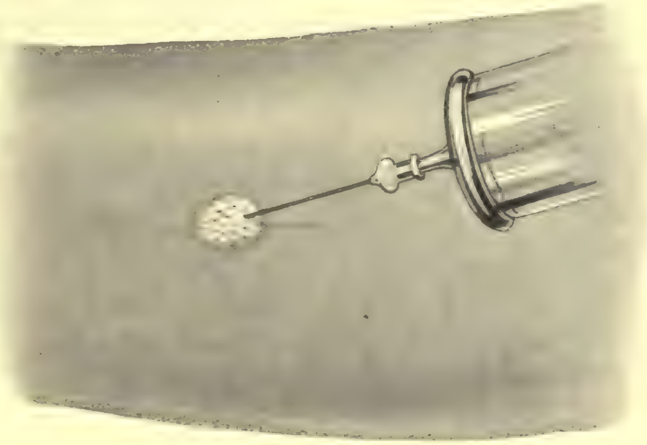

Fig. 131.—Bleb or weal produced by distension of skin.

Infiltration analgesia is suitable for those cases in which it is difficult, if not impossible, to inject around the nerve-trunks which supply the part, such as subcutaneous lipomata, cysts in the upper part of the breast, varicose veins, etc. Infiltration analgesia must not be employed for operations upon inflamed tissues.

Regional Anaesthesia.—Novocaine, eucaine, or stovaine may be employed.

If novocaine is used, a 2 per cent solution is prepared according to the following formula :

Novocaine	2 gram.
Sodium chloride . . .	·5 gram.
Distilled water	100 c.c.

(5 m. of a 1 in 1000 solution of adrenalin are added to each 50 c.c. of solution immediately before use.)

The syringe and needles employed are similar to those used for infiltration analgesia.

Technique of Injection.—The injection should not be made through or very near an infected area, and the skin at the site of injection must be rendered aseptic. A convenient antiseptic for this purpose is a solution of iodine which can be used as a paint. A few drops of novocaine solution are injected with a fine needle beneath the epidermis and a minute bleb raised. This causes practically no pain. A slightly larger needle is then introduced through this bleb and passed down to the nerve-trunk. The needle should be removed from the syringe before insertion, as it is easier to gauge the exact position of the point if the heavy syringe-barrel is not in place. Directly the point of the needle is in the neighbourhood of the nerve, the syringe is attached and the injection made.

The exact site of injection of course depends upon the nerve-supply of the part which is to be anaesthetized.

For instance, to anaesthetize the index finger it is necessary to block the median and radial nerves; or to produce anaesthesia for an operation for hallux valgus the anterior tibial, musculo-cutaneous, internal saphenous, and internal plantar nerves must be injected.

Regional analgesia is particularly suitable for operations upon the limbs on account of the anatomical arrangement of the nerves. The intercostal nerves as they lie beneath the ribs may be injected with ease, and in this way a very perfect analgesia is obtained for operations upon the thorax.

Injections of the lower intercostals produce analgesia of the upper part of the abdominal wall. If analgesia of the lower part of the abdominal wall is required regional analgesia of the lower intercostals must be combined with a local infiltration analgesia along the line of incision and through the whole thickness of the abdominal wall, because the twelfth dorsal, the ilio-hypogastric, and the ilio-inguinal nerves cannot be injected with certainty on account of their position amongst muscles.

The chief characteristics of regional analgesia are :

(1) When a suitable analgesic solution is introduced around a nerve, the whole area supplied by that nerve becomes analgesic—bone, muscle, skin, etc.

(2) The method can be used for operations upon inflamed tissues, provided that the injection around the nerve-trunk be made at a distance from the septic area.

(3) The analgesia lasts for several hours.

(4) The analgesic area is clearly defined by the anatomical distribution of the nerves.

Spinal Analgesia.—This method was first introduced and practised by Professor Bier. Essentially it is a regional analgesia of the nerve-roots within the spinal meninges, produced by a drug injected into the cerebro-spinal canal.

The substances commonly employed to produce spinal analgesia are stovaine, novocaine, and tropococaine. Of these stovaine is the most satisfactory for general purposes. Opinions differ considerably in regard to the actual technique. The methods described below are those generally adopted in this country.

A solution of stovaine is prepared containing 5 parts of stovaine, 5 of glucose, and 90 of distilled water. This fluid is sterilized and stored in hermetically sealed glass capsules each containing sufficient for one injection. The object of the glucose is to increase the specific gravity of the stovaine solution, so that it will sink in the cerebro-spinal fluid and at the same time gradually diffuse.

The syringe and needles by means of which the stovaine solution is injected into the spinal theca are illustrated (Fig. 132).

(*a*) Hollow needle with stylet.

(*b*) Cannula with wide base.

(*c*) Glass syringe barrel, 2 c.c. capacity, fitted with metal plunger.

(*d*) Glass capsule of stovaine solution.

The syringe and needles are sterilized by boiling. The cannula is then fixed to the syringe-barrel and the stovaine solution sucked up into the syringe. Air-bubbles must be removed and the proper dose measured off in the syringe by carefully expelling any excess of solution.

Some practice is necessary to introduce the needle with neatness and certainty. The space between either the 3rd and 4th or 2nd and 3rd lumbar vertebrae may be selected, but in children the former situation is preferable on account of the lower position of the lumbar cord. The puncture should be made *in the middle line.* The position of the operator's hands and the method of holding the needle are illustrated (Fig. 133).

As soon as the needle has passed through the supra-spinous ligament, the stylet should be withdrawn. The needle is then thrust slowly onwards until the point pierces the meninges, when the cerebro-spinal fluid will escape either in drops or continuously. The cannula with syringe attached is then passed down the needle into the cerebro-spinal canal and the injection made. Both are then withdrawn together.

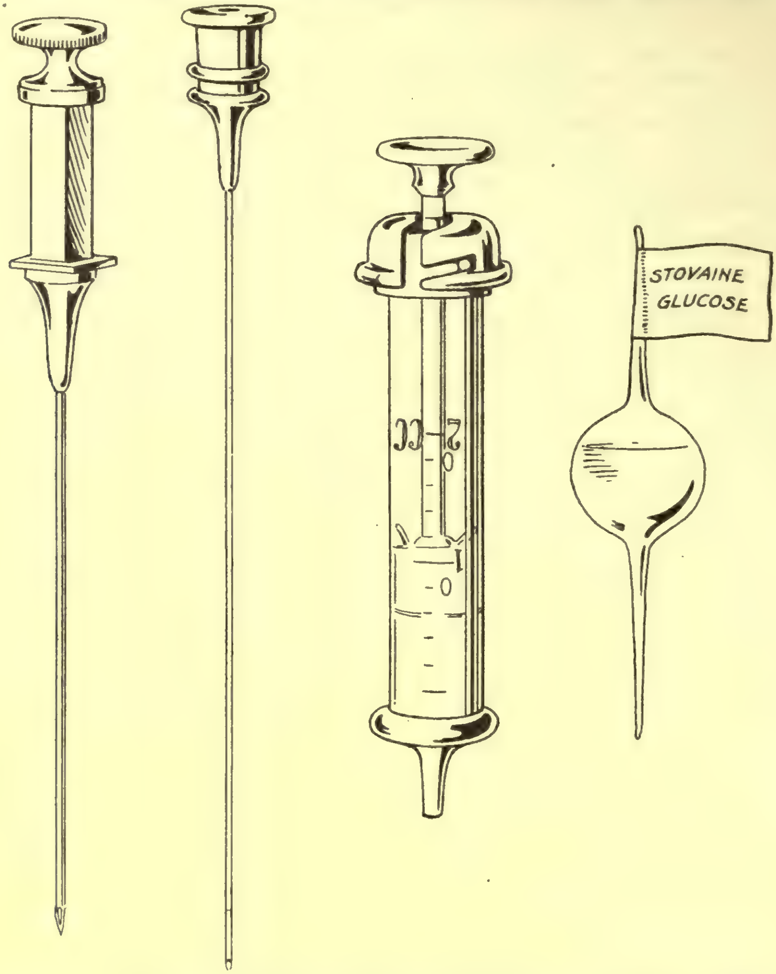

Fig. 132.—Syringe and needles for spinal anaesthesia with capsule of stovaine.

The position of the patient before injection is most important because the extent and position of the analgesia depend upon it. The curve of the spinal canal is so arranged that the stovaine will flow by gravity to the required level. The illustrations (Figs. 134, 135, 136) show various postures. If a unilateral analgesia is required the patient should be kept on the side for at least ten minutes. If bilateral analgesia septic condition exists. This applies especially to children, who under these circumstances are very liable to develop an acid intoxication. Spinal anaesthesia should if possible be used for acute septic conditions, such as osteomyelitis or appendicitis in children; failing this, ether or nitrous oxide.

The administration of an anaesthetic is in no way harmful to patients with compensated heart-lesions; if the cardiac condition is uncompensated, associated perhaps with dyspnoea, cyanosis, congestion of the lungs, and oedema or ascites, it is better to avoid a general anaesthetic if possible. Local and regional analgesia are most useful in these cases, but if a general anaesthetic has to be used ether with oxygen is better than chloroform. Asphyxia must be avoided, hence gas is generally inadvisable. Spinal anaesthesia must not be given to patients suffering from aortic disease or any other cardiac or vascular condition which renders them liable to syncope.

If active pulmonary disease exists, spinal or local anaesthesia, or chloroform should be employed.

Chloroform is usually given to women in labour and for the operation of Caesarean section. It is perhaps easier to obtain just the degree of analgesia required under these circumstances with chloroform, but if any contra-indication to its use exists there is no reason whatever why ether should not be substituted.

The existence of pulmonary disease is generally an objection to general anaesthesia, but this of course depends upon the severity of the condition. Only under conditions of absolute necessity should a general anaesthetic be given to patients suffering from acute bronchitis, acute pneumonia, or extensive phthisis. Chloroform is then preferable to ether, being less irritating.

In the presence of severe shock from haemorrhage, a ruptured viscus, or other cause, or if the patient is in a very feeble condition, the intravenous infusion of ether in normal saline is probably the most satisfactory anaesthetic.

OVARIOTOMY

By Professor Archibald Donald
(Manchester)

History.—Peculiar interest attaches to the history of ovariotomy. It was the first abdominal operation to be extensively practised, and it was the one which prepared the way for modern abdominal surgery. The reasons for this are not far to seek. Before the operation became general, patients were frequently met with whose lives were rendered miserable by ovarian tumours which had assumed large and even enormous proportions. In the later stages of the disease the general health was seriously affected. As the tumour increased in weight the patient became emaciated and enfeebled. No wonder, therefore, that the patients were ready and even eager to submit to operation in the face of great risk, and—in the days before anaesthetics—of acute suffering.

If we look back on the early operations we find that the tumours were almost invariably very large. In Macdowell's first case the total weight of the tumour was twenty-two and a half pounds. In Clay's first case the tumour weighed seventeen pounds, but that was the smallest of any in the list of his first twenty-two cases. Most of the tumours were over twenty pounds, and weights of thirty, forty, and even fifty pounds were found amongst these twenty-two.

While the technical difficulties of these early cases were often very great, some of the patients, even in these days before antiseptic or aseptic surgery, did very well. The reason probably was that it was often not necessary to introduce the hand into the abdominal cavity. After tapping, the collapsed cyst was drawn out until the pedicle appeared in the abdominal wound, when it was tied and dropped back. The death-rate, in dealing with small cysts which required much intra-abdominal manipulation, would probably have been much greater in these early days.

The first operation of genuine ovariotomy was performed by Ephraim

Macdowell in 1809. He was the son of Scottish-Irish parents and had studied at Edinburgh University. He was born in the State of Pennsylvania but practised in Kentucky. He is stated to have performed ovariotomy thirteen times with eight recoveries. The next surgeon to report a successful case was Nathan Smith of Connecticut, who operated in 1821. Lizars of Edinburgh had his first successful case in 1825, and after that date during the next seventeen years we have reports of single operations from various parts of the country.

The establishment of the operation was due to Charles Clay of Manchester, whose first ovariotomy was performed in 1842. He was the first to operate on a large series of cases, and to him chiefly belongs the credit of showing that ovarian tumours could be removed with a fair prospect of success. In 1880 he had performed 395 operations, with 101 deaths. Operations in this country began to be much more frequent after 1850. In 1851 Baker Brown performed his first ovariotomy. In 1858 Spencer Wells, after having assisted Baker Brown, commenced to operate, and in 1862 Thomas Keith of Edinburgh, and in 1867 Lawson Tait of Birmingham, began their series of cases. All of these men did something to help on the work, but there is no doubt that it was due to Spencer Wells's absolute frankness in publishing the results of every operation in a large series of cases, that ovariotomy was finally established in a position which silenced, if it did not convince, those who had hitherto objected to it.

The foundations of intraperitoneal operations having been once laid, the work went on rapidly, especially after the introduction of antiseptic, and later of aseptic, surgery. Exploratory incisions in obscure pelvic conditions gradually made plain many problems of ovarian, tubal, and uterine diseases. General surgeons were encouraged to open the abdomen for diseases which, up to then, had been regarded as suitable only for medical treatment, and the result is now seen in the surgical treatment of diseased conditions of the appendix, stomach, gall-bladder, and intestines.

It may be of some interest to notice the advances of technique in the operation. Macdowell used a long incision, extending generally from the pubes to well above the umbilicus, and in some cases reaching to the borders of the ribs. The pedicle was transfixed and tied by a long ligature, the end of which was left hanging out of the abdominal wound. Nathan Smith used a short incision, tapped the cyst, cut the ligature with which the pedicle was tied, and dropped the pedicle into the abdomen. Baker Brown used the short incision, divided the pedicle with the actual cautery, and closed the abdomen completely. Spencer Wells over a long series of cases clamped the pedicle outside the abdominal wound. With the introduction of antisepsis the dropping of the pedicle became general. Thomas Keith introduced drainage by the glass tube, and a large number of his cases were drained in this way. With the introduction of asepsis the drainage tube became almost obsolete.

Mortality.—The mortality of ovariotomy is even now somewhat difficult to estimate. Only a large number of cases can give a fair estimate. Any one operator may have a run of forty or fifty easy operations ; but on the other hand, he may have a succession of difficulties which tax all his resources. Ovariotomy may be one of the simplest operations, or it may be one of the most difficult. It depends on the type of tumour, the complications met with, the age and condition of the patient, and accidents during the operation.

Type of Tumour.—Simple cysts, follicular cysts, or lutein cysts, cyst-adenomata with narrow pedicles and no adhesions, present no difficulty. Except for rare accidents there should be no mortality.

Dermoid tumours, very large cyst-adenomata, and papilliferous cysts furnish a rather higher mortality, but still a very small one in the absence of complications. The mortality after the removal of malignant cysts is still higher.

Dr. Fletcher Shaw has given me the following analysis of the ovarian tumours removed in St. Mary's Hospital, Manchester, from July 1911 to December 1913—two and a half years:

Multilocular ovarian cyst	111
Unilocular ,, ,,	13
Papillomatous ,, ,,	24
Carcinoma of ovary	24
Sarcoma	8
Malignant adenoma	5
Endothelioma	1
Perithelioma	1
Fibromyoma	5
Dermoid	17
Parovarian	8
Lutein cysts	6
Myxoma	2
Cystic ovaries	20
	245

It will be observed that in 39 cases the tumour was malignant, *i.e.* in nearly 12 per cent ; and if we include papillomatous cysts we have 63 cases of malignant, or possibly malignant tumour, *i.e.* more than a fourth of all the cases.

Complications.—Adhesions may cause great difficulty, but if merely parietal, or to uterus or broad ligaments, they generally involve little additional risk. Intestinal adhesions are more dangerous.

Intraligamentous growth of the tumour may be a much more serious complication. The broad ligament may be opened out so that the tumour rests on the tissues of the pelvic floor. The peritoneum may be stripped off the posterior abdominal wall, almost as high as the kidney. In some cases of double intraligamentous growth the uterus may be so anchored on each side that it becomes necessary to remove that organ along with the ovarian cysts. An infected ovarian tumour or ovarian abscess, if its contents escape into the abdomen, may cause acute septic peritonitis.

Age and Condition of Patient.—Age makes little difference. Quite young children stand the operation well, and women of eighty years of age or more have frequently been found to be quite good subjects. Still there is always a little more anxiety in these cases.

The general condition of the patient, on the other hand, matters a good deal. Amongst cases in which a high rate of mortality exists are those of neglected tumour. In addition to the technical difficulties involved in their removal, there is generally emaciation and an enfeeblement of the resisting power, with a tendency to heart failure. As a result of neglected twisted pedicle there may be marked toxaemia and a low typhoid state. These cases, although now rare, are still found, and then operation is attended with great risk. The introduction of spinal anaesthesia has done something to diminish the danger from shock.

Accidents during or after Operation.—Amongst these may be enumerated injuries to bowel, bladder, and ureter, secondary haemorrhage, and at a later stage, adhesion of intestine.

All of these complications may lead to a fatal termination. In some cases death may be delayed for weeks or even for months, but nevertheless it must be taken into account when reckoning the mortality of the operation.

The statistical enquiry is also much complicated by what we may call compound operations. In the course of an ovariotomy it is not at all uncommon for the operator to attend to some other trouble in the abdomen or pelvis. It has already been noted that in order to make the operation safe it may be necessary to remove the uterus along with the ovaries. Or we may have a combination of ovariotomy and myomectomy, or of ovariotomy and appendectomy. Sometimes after the tumour has been removed it may seem advisable to fix the uterus to the abdominal wall, or to adopt some other method for the cure of prolapse. It is thus often difficult to know how to classify a case, and it would be quite possible to leave it out from one's statistics altogether. Thus, for example, where the uterus had been removed along with an ovarian tumour the case may be classified as a hysterectomy or as an ovariotomy, or as both.

I have collected all the operations I have performed in institutions during the last five years for ovarian tumours, excluding cases of exploratory incision in malignant disease where the abdomen was closed without attempting to remove the tumour.

The figures are as follows :

	Cases.	Deaths.
Manchester Royal Infirmary	106	3
St. Mary's Hospital	89	2
Nursing Home	57	0
	252	5

It will be seen that the mortality is just under 2 per cent, but it is interesting to analyse the cause of death in the five fatal cases.

In two cases the tumour was malignant : in one of these there were secondary growths in peritoneum and mesentery ; in the other the growth is described as a glandular carcinoma.

In the third case an ovarian cyst was removed from the right side, and on the left a large pyosalpinx was found which was removed.

In the fourth case the operation was undertaken as a last resort. The patient had an enormous tumour and was *in extremis*. Spinal anaesthesia was used, but she never rallied.

In the fifth case there was an adherent and inflamed appendix which was removed after a large ovarian tumour had been removed.

THE OPERATION

It is not necessary to describe all the technical details now commonly attached to abdominal section, as these are described in another article,[1] but certain points which are of importance may be mentioned here.

The following are the instruments required :

1 straight needle for marking abdomen.

4 Collins's bowel forceps.

2 scalpels, one for skin incision, and the other for use, if necessary, inside peritoneal cavity.

2 pairs ordinary scissors—one Mayo's scissors.

4 tetra forceps for fixing tetra-cloths or rubber sheets.

30 pairs Spencer Wells's artery forceps.

1 Doyen's retractor.

1 corkscrew.

1 trocar and cannula.

2 pairs vulsellum forceps.

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[1] See Article on Technique (pp. 283-368).

2 pairs sponge forceps.
2 aneurism needles.
4 pairs Spencer Wells compression forceps—two straight and two curved.
1 pair long dissecting forceps, one pair small dissecting forceps.
1 Reverdin needle.
1 Hagedorn needle-holder.
2 pairs long Spencer Wells forceps for Bonney needles.
1 Halstead needle-holder with thumb-release in case stitches are required deep down in pelvis.
Michel's suture machine and clip, with forceps for approximating skin edges.
Needles—2 "No. 1" Hagedorn; 4 "No. 4" Hagedorn full curved needles; 2 large and 4 small Bonney needles full curved; spare Reverdin needle.
Silkworm gut and catgut sutures.
Fine silk and fine straight intestinal needles for repair of intestine.

Sterilization of the Hands.—The plan which is used by the writer is as follows: Thorough scrubbing with soap and hot water for at least five minutes; then immersion of the hands in a hot saturated solution of permanganate of potash; removal of this by a hot saturated solution of oxalic acid. Then the hands are rinsed in sterilized water, and finally, after the hands have been thoroughly dried with a sterilized towel and powdered with sterilized French chalk, dry rubber gloves are pulled on.

Sutures and Ligatures.—Catgut alone is used within the peritoneum. Formalin-iodine catgut is employed. Silk is never used inside the peritoneal cavity, except on the rare occasions when the intestine has to be stitched, when very fine silk is employed for this purpose.

Position of the Patient.—The table should be one with which it is possible to get the Trendelenberg position very simply and rapidly; the anaesthetist should be able to manipulate it by the simple turning of a handle or screw. It is best to stand on the left hand of the patient, at least for those who are not left-handed, as in this position the pelvis is most easily explored by the right hand. The operation in cases of large abdominal tumour is generally begun with the patient lying flat, so as to avoid pressure on the diaphragm and interference with the patient's respiration. After the tumour has been removed the patient is turned into the Trendelenberg position, so that the pelvis may be thoroughly inspected.

The choice of *anaesthetic* I generally leave to the anaesthetist, but I have a strong preference for the open ether method. With this there is never any anxiety, and one's attention is not distracted from the operation by an uneasy feeling that the patient may be having too much anaesthetic.

Nearly forty years ago Lawson Tait used this method, and it is interesting to read what he says about it: "In the first place, so far as its present use has gone, it is absolutely safe. In my own practice it has been used, on a rough estimate, between five and six thousand times, and not only have I had no accident from it, but its use gives me no anxiety whatever, and whilst I am engaged in operating my mind is absolutely at rest concerning the anaesthetic." He went rather further than most of us would care to do, as his next sentence shows: "In the next place it may be administered by any one, and when I say that in the whole of my Hospital practice, for nearly three years, the ether has been administered for all operations by the sister in charge or by a nurse, I think I give testimony sufficient as to my confidence in the safety of the drug."

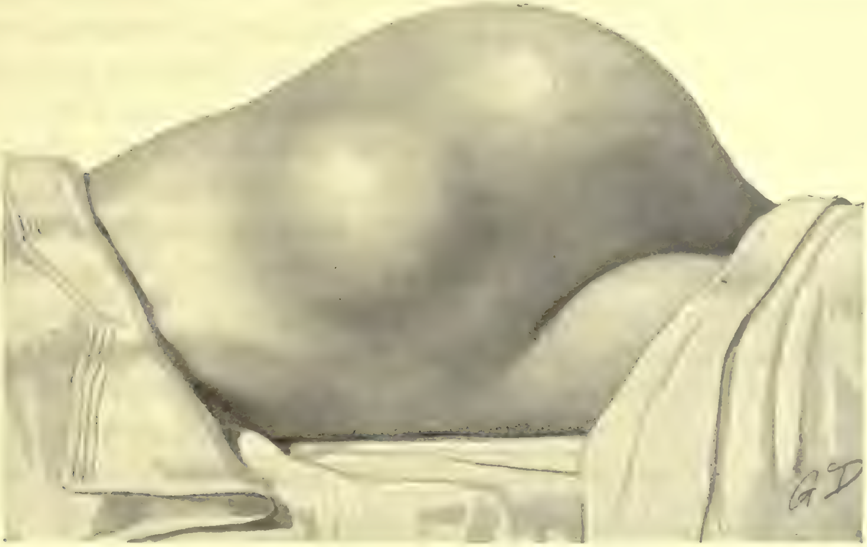

Fig. 137.—Shows a fairly typical profile view of a large ovarian tumour. (From a photograph.)

Examination of the Patient under the Anaesthetic.—This I regard as a most important point. Under the anaesthetic it is often easy to make out points with regard to the tumour which were till then obscure. This applies to inspection as well as to palpation. It is astonishing sometimes how the outline of the tumour will be revealed when muscular rigidity is abolished (Figs. 137 and 149). A careful study of the contour and profile view of the abdomen is always advisable, and then a careful inspection and palpation of the abdomen, and in many cases a bi-manual examination should follow. This will not only enable us in some cases to form a more correct view as to the nature of the tumour, but it may even be the means of causing one to decide not to open the abdomen.

The Incision.—As we have noted, the first cases were operated on by a long incision. A little later it began to be suspected that the length of the incision had something to do with the mortality, and that the long incision added somewhat to the danger of the operation. After this it began to be the custom of the surgeons to vie with one another as to the shortness of the incision through which an ovarian tumour could be removed, and the length of the incision was always noted carefully in recording the operation. Nowadays there is much to be said in favour of making the incision sufficiently long to remove the tumour entire and without tapping. The tabular account as to the varieties of ovarian tumour furnished by Dr. Shaw shows that nearly 12 per cent of all tumours are definitely malignant. But in addition many apparently simple cyst-adenomata have been found to contain malignant portions when carefully examined by the microscope after removal, and papilliferous tumours which though clinically benign to start with, may grow again if some of these cells are implanted on peritoneal surfaces, form nearly 10 per cent of ovarian tumours. The scattering about of malignant cells in the general peritoneal cavity may of course lead to recurrence. This recurrence often takes place in the abdominal wall, and is due to implantation of the cancer cells on the raw surface during removal. The advantage of the long incision is still greater in cases where there is some infection of the contents of the ovarian tumour, as the infection of the peritoneal cavity may lead to a primary fatal result.

One need not hesitate to extend the incision even as high as the ensiform cartilage, but this is rarely necessary. Even large tumours are more or less compressible, and very often the tumour is irregular, so that it can be manipulated and brought out from an incision which does not reach to its upper limits. The best plan is to make a fairly long incision to begin with, provided the tumour is a large one, and then to extend it by degrees until one reaches a point at which the tumour can be safely removed without rupture.

It is a good plan, in order to secure accurate adjustment of the divided skin edges, to make transverse markings with a sharp needle across the line of incision before dividing the skin (Fig. 138). This plan has been comparatively recently reintroduced, but it is of interest to note that it was first advocated and practised by Lizars nearly a hundred years ago. The incision is in the middle line, and may either go between the recti muscles, or the sheath of one rectus may be divided, the muscle drawn back, and the fascia then opened, so that when the abdomen is closed the rectus overlaps the incision in the fascia.[1] The first incision should be made with the knife through the skin and superficial fat right down to the fascia of the rectus. The bleeding points are then caught by pressure forceps which are left on. The incision is then completed through the deeper structures and peritoneum by means of a pair of Mayo's probe-pointed scissors. If the tumour is of small size and lies in the pelvis, a view of it can generally be obtained by pulling on the edges of the incision, or by inserting a large retractor at the lower angle. The incision is then extended as high as necessary in the manner described.

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[1] Different methods of making the abdominal incision are described in the Article on Technique (pp. 283-368).—EDITORS.

The *appearance of the tumour* gives a guide as to the kind of growth we are about to deal with. In the ordinary cyst-adenoma or papilliferous cyst, the tumour is of a bluish-white pearly aspect. A colloid ovarian tumour has generally thin walls through which the colour of the contents, which is frequently of a dark blue, can be seen. A papilliferous cyst may have warty masses on its surface. An intraligamentary cyst is covered with peritoneum and shows a reticulum of vessels. The presence of free fluid in the abdomen indicates rupture of a cyst, tubercle, malignancy, a papilliferous cyst, or a solid tumour which is insufficiently nourished and which therefore acts as a foreign body and causes irritation of the peritoneum. An ovarian cyst with a twisted pedicle is generally of a dark blue, chocolate, or black colour, but in other cases may be of a dull yellowish-white appearance.

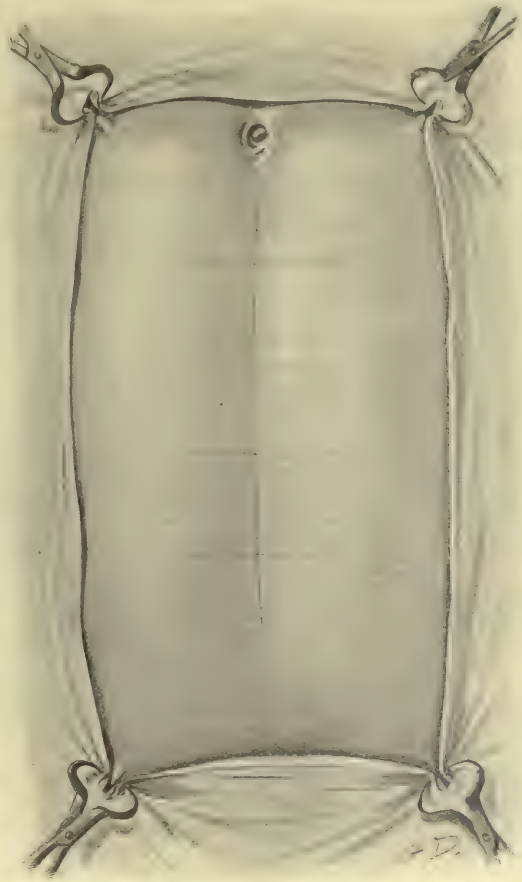

FIG. 138.—The abdomen with sterilized sheets clipped to the skin. The lines are made by the point of a needle, to facilitate accurate adaptation of skin-edges.

The practical points with regard to the above remarks are as follows : In colloid cysts we must handle the tumour with the greatest care, as the danger of rupture is very great; in intraligamentary cysts, as will be pointed out later, the first step in the operation is the incision of the peritoneal investment ; and in cysts with a twisted pedicle care must be taken not to pull on the cyst or handle it too roughly, otherwise the small pedicle may be torn through.

One has to be prepared for an error in diagnosis. It is always possible even for the most careful to open the abdomen in a case of pregnancy, especially if there be some abnormality, such as vesicular mole or hydramnios. On bi-manual examination, a portion of the uterus just above the internal os may be so compressible as to make one feel almost certain that there is no part of the uterus intervening between the two hands, and thus the upper part of the uterus may be mistaken for a cystic tumour which is separable from the uterus. In other words, Hegar's sign of pregnancy may actually mislead us. There should be no difficulty, however, in recognizing a pregnant uterus when the abdomen is opened. Fibroid tumours also are easily recognized. There are cysts, however, derived from other organs which are more difficult. Some of these are retroperitoneal. The important point is to recognize that the latter are covered by an investment of peritoneum, often with large veins coursing over them. Renal tumours, retroperitoneal sarcomata, and chylous cysts may all assume large proportions, and may be operated on in mistake for ovarian tumours. If, however, we find a peritoneal covering, and especially if we find that the mesentery has been opened out by the tumour, then our first step must be to explore the pelvis and to see if the tumour is uterine or ovarian. Comparatively small renal tumours which lie in the pelvis are rather more difficult to distinguish, but the peritoneal covering always affords a clue. Large splenic tumours may sometimes be mistaken for ovarian tumours, but the mistake is obvious the moment one is able to get a view of the tumour.

Delivery of the Tumour.—Having made our preliminary diagnosis the skin is now covered over by tetra-cloths or by india-rubber sheets which are clamped on each side to the peritoneum, so that the skin of the abdomen is entirely covered. The gloved hand is now introduced into the abdomen and carefully swept over the surface of the tumour. In the great majority of cases if adhesions exist between the tumour and the abdominal wall they can be swept off with moderate pressure. Omental adhesions can be easily felt, and in most cases the omentum can be pulled down or the tumour can be rotated so that the adhesions are visible. If not very firm they may be sponged off with a piece of dry gauze; otherwise the omentum must be ligatured with catgut and divided with scissors. If the intestine is found to be adherent to the tumour, the greatest care must be exercised. Intestinal adhesions must only be detached in sight. The intestine is gently pulled so as to define the adhesions, which are then divided by scissors. If they are very firm it is best to snip the surface of the tumour and strip a portion of the cyst wall off rather than run the risk of injuring the intestine. It is important to deal with these adhesions on the upper part of the cyst wall while the cyst is entire, even if one wishes to tap before removing the cyst. It is much easier to separate adhesions when there is something to work against, than to pull off a collapsed cyst from adherent omentum or intestine. As a general rule, the upper two-thirds of the tumour give rise to comparatively little difficulty. There are, however, exceptional cases in which adhesions in the upper part are firm and extensive, but these will be referred to later.

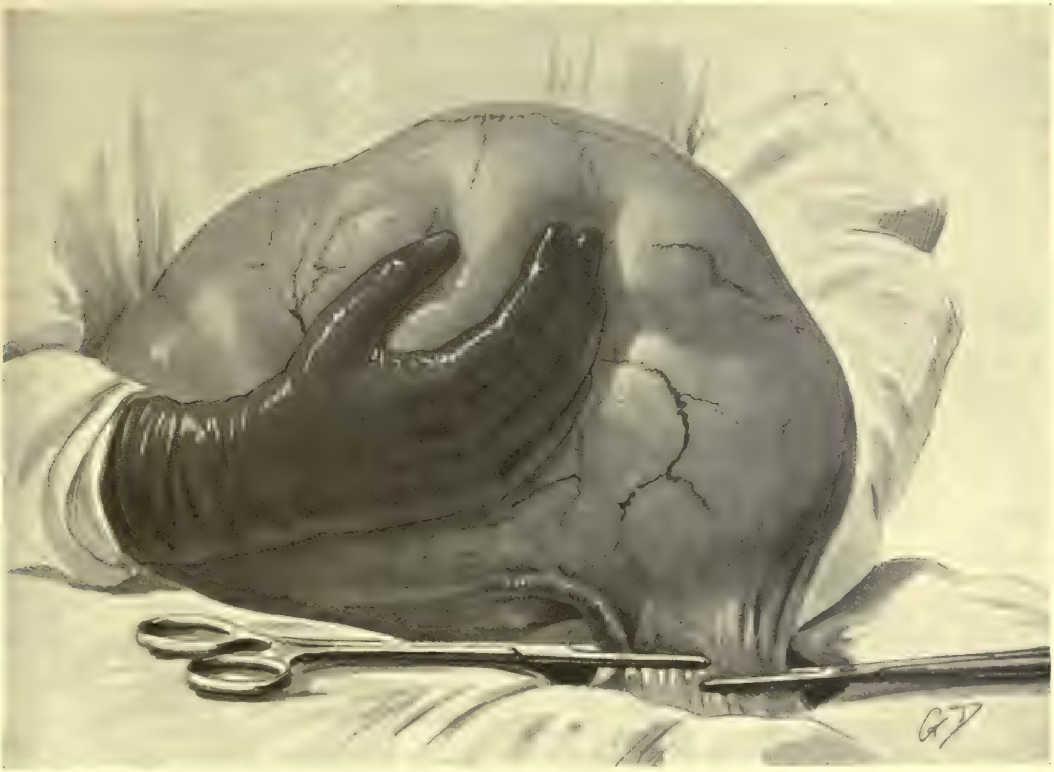

FIG. 139.—Forceps have been applied to the pedicle of the tumour, which is held up. The left forceps is on the Fallopian tube, the right one on the infundibulo-pelvic ligament. The ovarian ligament is behind and cannot be seen. (From a photograph.)

When we have ascertained that there are no adhesions, or when we have separated any adhesions that exist, the tumour is then delivered by careful manipulation. The tumour must be supported by an assistant, so that it does not drag on the pedicle or press on the abdominal wall (Fig. 139). The intestines are kept back by gauze packing. The roll of gauze should be threefold and about twelve inches wide and six yards long. It is gently packed in at the upper part of the abdomen, while the assistant holds up the edges of the wound, until the intestines are quite concealed.

The end of the roll should be clipped by forceps to the sheet covering the abdominal wall. A large abdominal retractor (Doyen's) is now inserted into the lower end of the incision, and is pulled on by an assistant, so as to show the pedicle clearly.

Dealing with the Pedicle.—The pedicle is now clamped by large-sized Spencer Wells forceps. Three points must be attended to—the infundibulo-pelvic ligament, the Fallopian tube, and the ligament of the ovary. It will often happen that the forceps which clamps the Fallopian tube also includes the ovarian ligament (Fig. 139). When these points are secured the vascular supply to the tumour is controlled in most cases. In other cases, however, the pedicle is very broad and thick, and the

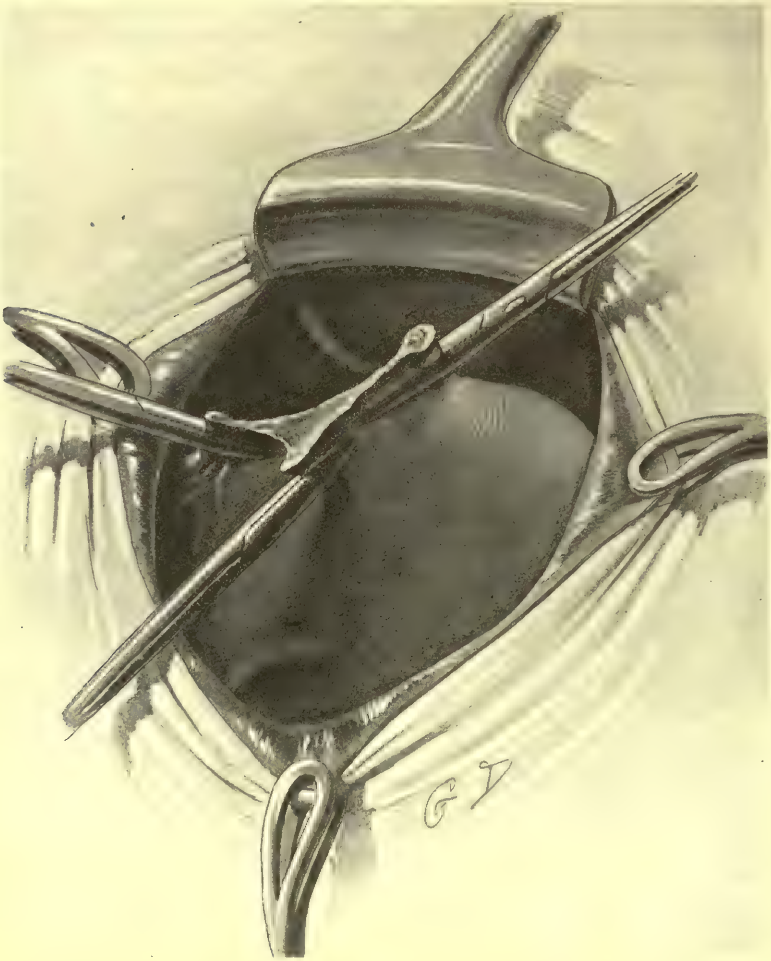

FIG. 140.—The tumour has been removed and the retractor introduced. The right forceps grasps the Fallopian tube, the middle one the ovarian ligament, and the left one the infundibulo-pelvic ligament. The patient is in the Trendelenberg position. The tumour in this case was on the left side. (From a photograph.)

vessels are spread out. In this case additional forceps are applied. The pedicle is divided on the outer or distal side of the Spencer Wells forceps, and the tumour removed, and handed over to a nurse, who receives it in a basin covered with a sterilized towel. In the case of large tumours it is important to warn her of the weight. If she is unprepared for the great weight the tumour may drop on the floor. I have seen a case in which this happened, with the result that the tumour burst and the floor of the operating theatre was flooded with ovarian fluid.

The patient is now put into the Trendelenberg position and a good view obtained of the pelvis (Fig. 140). More gauze is packed in, so as to shut off the field of operation ; nothing should be seen but the pedicle and the pelvic organs. No loose swabs should be introduced ; all the packing should be done by rolls of gauze, and each roll of gauze should be secured by means of forceps to the sheet covering the abdomen. The pedicle is now ligatured in sections with formalin-iodine catgut. The important point is that each portion should be carefully tied off, and that no tissue should intervene between adjacent ligatures. When the pedicle is tied it should be carefully watched for a minute or so to see if there is any oozing. It sometimes happens that a vessel is punctured by the needle in transfixing the pedicle, and bleeding may thus occur below the ligature, either into the peritoneal cavity or between the layers of the broad ligament, causing a haematoma. As long as one knows of the possibility of these accidents they are easily prevented, or remedied. In using catgut three knots should always be tied. It is useful to tie a "granny," as the second loop pulls the first one tighter, and then on the top a reef turn is taken. It is a good plan after the pedicle has been ligatured to cover in the raw surface with peritoneum. This may be done by a purse-string suture picking up the peritoneum below the raw surface (Fig. 141), or the uterine end of the pedicle may be drawn towards the infundibulo-pelvic end by means of one or two stitches.

The condition of the other ovary is then ascertained as it may also have to be removed. Then one must carefully look to all the parts which were adherent, and which were separated. If there is any bleeding a ligature may have to be applied, or the raw surface may be covered over by stitching. As a rule, separation of moderately firm adhesions does not give rise to much haemorrhage. The ligature of the pedicle and subsequent covering over with peritoneum and other stitching is done with a Reverdin needle or with a full-curved Bonney needle held in a long Spencer Wells forceps. The tissues to be transfixed are held up by a dissecting forceps in the left hand. If the omentum is torn and ragged it is better to remove it so that there may be no risk of its causing obstruction of the bowel.

It is now as well to take the opportunity of examining certain other organs.

The appendix should be looked to, the kidneys felt, and if there is any doubt as to the tumour being malignant the intestines should be thoroughly examined. In some cases it is wise to examine the gall-bladder and pyloric end of the stomach.

All the fluid blood and clots, as well as any ovarian fluid which may have escaped into the abdomen, should now be removed by careful swabbing. It is not customary now to wash out the peritoneal cavity. In cases of infected tumour or ovarian abscess the question of drainage will have to be considered. All swabs which are used for the purpose of cleansing the peritoneum should be held in the hand or grasped by long forceps, which should not be removed while the swab is in the abdomen. Before

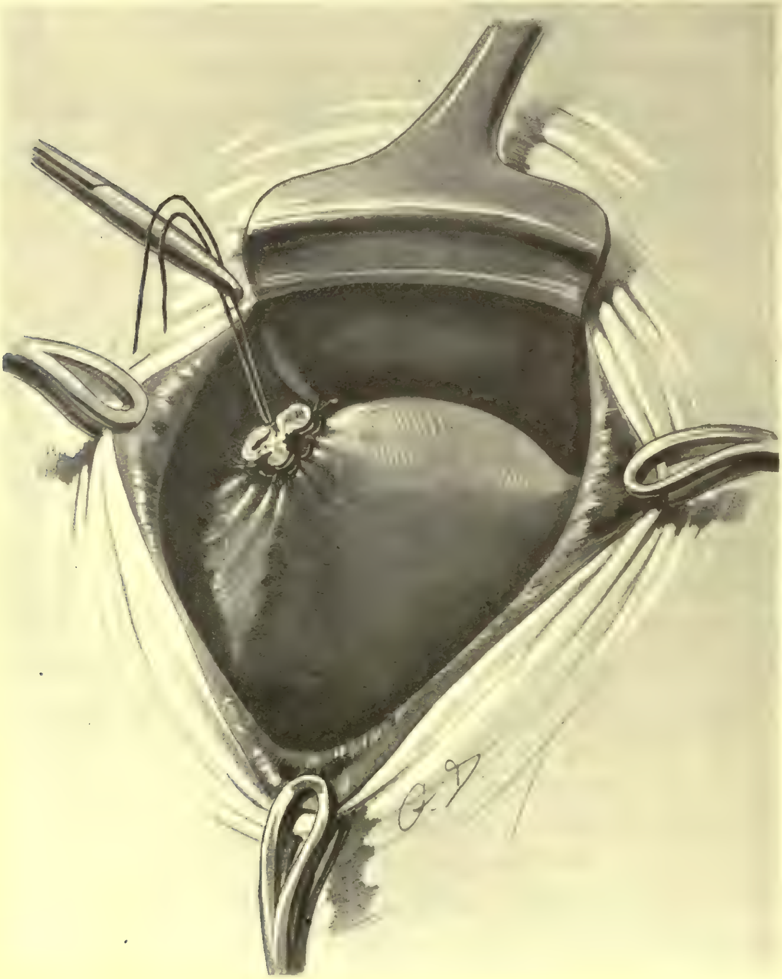

FIG. 141.—The forceps have been tied off and the purse-string suture applied, so as to bunch up the pedicle.

closing the abdomen, it is as well to look again at the pedicle or pedicles, so as to make quite sure that there is no haemorrhage. The gauze is then withdrawn carefully, the tetra-cloths and all pressure forceps on the abdominal wall are removed, and the peritoneum on each side of the incision seized with forceps.

Closing the Incision.—There is some little difference of opinion as to how the abdomen should be closed, but as a general rule most surgeons are agreed that catgut should be used for the peritoneum and fascia, but that these should be reinforced by a few deep stitches of some stronger, non-absorbable material, such as silkworm-gut or silk. These should go through skin and almost the whole thickness of the abdominal wall. Many surgeons use two rows of sutures of continuous catgut, the first row including transversalis fascia and peritoneum, and an upper row to bring the fascia over the rectus into contact. The continuous catgut suture is always open to the objection that if it breaks at one point the wound may gape through its entire length, and for this reason I use interrupted catgut sutures. For bringing the edges of the skin together, some prefer the subcuticular suture, which may be of catgut, silkworm-gut, or silk. Personally I use Michel's clips which are rapidly applied by means of the special magazine. For the deeper parts of the abdominal wound I have found the new model of the Reverdin needle of great help. By using this and by the use of the clips I find the abdomen is closed much more rapidly than by ordinary needles. No doubt by using a long curved needle in one's hand with a continuous suture the stitching may be performed fairly rapidly, but I think there is always a disadvantage in handling a needle with a gloved hand, as it is very difficult to avoid cutting or puncture of the glove. If the anaesthetist prefers it, the patient may be restored to the flat position after the peritoneal layer of the incision is closed. If there has been any escape of pus during the operation it is advisable to swab the incision in the abdominal wall with a 2 per cent solution of iodine before closing the wound. In all cases this solution should be painted over the incision after the operation has been concluded.

In exceptional cases it may be decided to tap the cyst before removing it. This may be done where there is no doubt about the diagnosis of a simple, *e.g.* a parovarian cyst, or in cases where the tumour is undoubtedly malignant but there has already been escape of the contents into the abdominal cavity, or in papillomatous cysts where the warty masses are already implanted on peritoneal surfaces. When tapping is used the simpler the form of trocar and cannula the better. The complicated instruments which were invented for this purpose are not necessary, and in fact are rather apt to tear the cyst wall. The right-angled cannula to the end of the horizontal portion of which is fixed a rubber tube, is useful, or we may employ a simple trocar and cannula below which is held a large glass funnel connected with a rubber tube. All these appliances must be sterilized before use. But in every case in which the tumour is tapped it is difficult to avoid making a mess. The most difficult cases to deal with are those of colloid cysts. The walls of these cysts are so thin that it is almost impossible to avoid tearing them, in fact in quite a number of cases they have already burst, and the contents are spread about in the abdomen. The thick tenacious glue-like material is very difficult to remove. It can only be gathered up by the hands and it clings to intestines, to peritoneum, and to the operator's hands. Much careful sponging and swabbing is required.

The use of drainage either by gauze or by a tube will be referred to when we come to speak of the cases in which it is required.

The dressings of the abdominal incision are generally of the simplest character. A broad strip of sterilized gauze is placed over the incision, and this is fastened down with strips of plaster, then a large pad of Gamgee tissue is put on, and is fixed by an abdominal binder of the many-tailed variety.

Variations in the Method of Operating in Special Cases

1. Intraligamentary Cysts.—These are divided into parovarian cysts and ovarian cysts with intraligamentary development. The former are unilocular and have no pedicle, the latter may be multilocular and always have a pedicle, but they resemble each other in that they both have a covering of peritoneum. An intraligamentary cyst has the characteristic appearance of being covered by a fine membrane in which run small vessels. The surface, therefore, has a pale pink or streaky look. It is very important that the nature of the cyst should be recognized before beginning to operate. The tumour is often quite sessile, owing to its relation to the broad ligament, and it cannot be drawn out or delivered through the abdominal incision until it is freed from its capsule. The first step in the operation is to incise the peritoneal covering. It is generally easy to find the right layer. Then this covering is separated with the hand or with probe-pointed scissors. The capsule retracts as the tumour comes out.

Great care is necessary when one approaches the pelvic cellular tissue. The tumour may lie in contact with the ureter or with the large abdominal or pelvic blood-vessels, and it may have to be carefully stripped from these. A portion of the tumour may have worked its way down into the cellular tissue of the pelvis, and in this way some curious relationships may be established. In one memorable case amongst my first few operations, the tumour had made its way into the cellular tissue behind the rectum. When the cyst has been removed from its capsule the pedicle, if there is one, should be dealt with in the usual way.

The cavity from which the tumour has been raised is then carefully inspected to see if there is any oozing or bleeding. Should there be fairly free oozing at any part it is better to pick up this part with forceps and either tie it or under-run it with a catgut ligature. In most cases the haemorrhage is easily controlled in this way.

As a rule the operation is completed by trimming the peritoneal capsule, cutting off superfluous portions, and bringing the edges of the capsule together by a continuous suture, so as to cover over the cavity from which the tumour has been enucleated. It is, of course, very important, before doing this, to be quite certain that all oozing has ceased. Sometimes it is a good plan to close the cavity from below by several rows of buried sutures. In some rare cases it is found necessary or expedient to terminate the operation by the so-called 'marsupialization' of the cyst capsule. When this plan is adopted the edges of the capsule are brought up towards the abdominal incision, and are carefully stitched round to the peritoneum in such a way that the abdominal cavity is shut off, and there is direct communication between the external wound and the interior of the cyst capsule. This is then packed more or less firmly with gauze, the end of which is brought out of the abdominal wound. This method may be adopted when there is free oozing from numerous points, which cannot well be controlled by a ligature or suture, and which can be stopped by a comparatively light degree of pressure. It may also be used in cases where a portion of the cyst wall has been left behind, *i.e.* where it has been found impossible to remove it entirely. The gauze packing is removed by degrees in the course of three or four days. It may be renewed, or a rubber tube may be put in and the cavity washed out with some saline solution or sterilized water. The cavity generally contracts rapidly, so that in the course of a week or a little more only quite a small quantity of gauze is required to fill it. These cases of free bleeding in a broad-ligament cavity, or incomplete removal of cyst wall, may be also dealt with by making a counter opening into the vagina. After pulling an end of gauze into the vagina, the cavity is tightly packed with gauze, and then closed on its abdominal aspect.

2. Malignant Ovarian Tumours.—The main points which concern us here are not so much details of the actual operation, but questions as to whether an operation should be undertaken at all, or when once it has been begun, as to the limits to which it ought to be carried. I have been more and more convinced of the advisability of giving patients the benefit of an exploratory incision in all cases in which there is the least possibility of an error in the diagnosis of inoperable malignant growths.

It is quite possible for a non-malignant abdominal tumour to simulate a malignant ovarian growth very closely. Solid or fairly firm tumours which are not malignant, but which are associated with free fluid, may often be mistaken for cancer of the ovary. Sometimes one meets with an ovarian cyst in which a very large loculus has ruptured, while the remaining portion is composed of firmly compressed smaller loculi, and this gives rise to the feeling of an apparently solid tumour which often has a concave irregular outline with a great quantity of fluid in the abdomen.

I was once asked to see a case which was diagnosed as bilateral malignant ovarian tumour. The patient's abdomen was distended with free fluid. There was a hard mass in each iliac fossa and the uterus was embedded between these masses. *Per vaginam*, a hard tumour could be felt at the back of the uterus, almost calcareous in consistence. The patient had been tapped on several occasions and ascitic fluid drawn off. I asked permission to be allowed to make a small abdominal incision, instead of tapping. I then found that the patient suffered from multiple hydatid disease of the pelvic floor. Some of the cysts had become inflamed and were surrounded by dense fibrous tissue. I was fortunately able to clear these old cysts out of the pelvis, with the result that the patient made a complete recovery.

But there are reasons for operating even when the diagnosis seems undoubted. The removal of a malignant tumour may be followed by complete and permanent recovery, and in other cases there is freedom from recurrence for some years. Even when the whole tumour cannot be removed it may still be possible to give the patient great relief by removal of a large cyst, and it is sometimes astonishing to find the improvement that occurs in the patient's general condition after such an operation. A clinical diagnosis between a malignant and an innocent papilliferous cyst is not possible, and if the warty growths have become implanted upon peritoneal surfaces they are clinically malignant. Yet we know that in some cases of papilliferous cysts, after removal of the main tumour, the secondary growths seem to disappear. In cases where one can feel undoubted thickening of the omentum, or isolated masses in the upper part of the abdomen, and where the patient is markedly cachectic, it is generally best not to operate, although even in these cases I have seen what appeared to be an extraordinarily good effect of opening the abdomen,—almost similar, for a few months, to what takes place, for a longer period, after opening the abdomen for tubercular peritonitis.

The operation for a malignant ovarian tumour is generally more dangerous, and may be much more so, than that for a non-malignant tumour. In my own experience, these operations account for nearly half of my mortality. This depends upon local conditions and the general condition of the patient. As regards the local conditions, the growths are generally soft and vascular ; they often invade the pelvic floor and the broad ligament. If one begins to interfere with the growth there is generally no drawing back. When the malignant growth invades the broad ligament, the dangers of the operation may be extreme. The tissue is generally very friable, and can only be brought away by the finger ; the portions that are left are often so soft or friable that it is impossible to ligature them with catgut or under-run them. One has carefully to weigh the possibilities of removal before starting to attempt it. My own feeling in the matter, however, is that many cases which seem difficult or almost impossible sometimes turn out comparatively well, and that as a result the patient has a few months or years of comfort. In one case which looked most unpromising, and where the growth was undoubtedly malignant, the patient survived and had a comfortable time for six years after the operation. At the end of that time she returned with evident recurrence in the abdomen. I made an exploratory incision, but this time found that the growth was too advanced for removal.

3. **Papilliferous Cysts.**—Their removal gives rise to much the same difficulties as malignant growths. They are not infrequently bilateral, and they tend to invade the broad ligament and to burrow deeply in the cellular tissues beneath the peritoneum. When the cysts have ruptured, and there is much warty growth scattered about on the peritoneal surfaces, the question arises as to how far we should eradicate these isolated masses. It is beyond question that after removal of the main growth many of these secondary masses disappear spontaneously, but this is a termination which we cannot rely on. Each case has to be judged on its merits. My own practice is to remove these isolated growths as far as possible. If, however, one finds a large mass firmly rooted on some vascular portion of the abdominal wall, or on the intestine, it is better to leave it. When these tumours are bilateral and deeply imbedded in the broad ligaments it is often the easiest, as well as the safest course to remove the uterus along with the cysts.

4. **Inflamed Ovarian Cysts and Abscesses of the Ovary.**—Inflammation of the cyst wall and of the adjacent peritoneal surfaces may be caused by irritative processes, quite apart from infection, while suppuration in the contents of the cyst, and inflammation of the cyst wall accompanying this, are of course always due to pathogenic organisms. The results, however, as regards the operation are very much the same, except that in the case of infective processes there is much more risk of septic peritonitis following the operation. The most common cause of non-septic inflammation of the cyst wall is probably the leakage of irritating ovarian fluid into the peritoneal cavity either by tapping or by rupture. Loss of vitality in the cyst wall also sets up irritation which in the earlier stages is not due to organisms.

A non-infective irritation may cause very dense adhesions, and when these exist between the cyst wall and the peritoneum, it is sometimes very difficult to recognize and to separate these structures. There is always a risk of separating transversalis fascia from peritoneum instead of peritoneum from cyst wall, or if we go rather deeper we run the risk of penetrating the cyst wall and then separation becomes much more difficult. A little experience, however, is generally sufficient to teach us when we have reached the right layer. If we are in doubt, it is not a bad plan, if the tumour is not too large, to make an incision well above the upper limit of the tumour, so as to open into the free peritoneal cavity. If we extend the incision downwards we can then separate the tumour from above. The adhesions may not be limited to parietal peritoneum but may be universal. Sometimes the tumour has to be stripped from the lower surface of the liver, and that, of course, is a process which may be accompanied by very free haemorrhage. The omental and intestinal adhesions may be very firm, but they are generally separated without great difficulty if we observe the methods already mentioned. It is important when we find intestine stretched out over the tumour to be certain that we are dealing with adhesions and not with an anatomical separation of the mesentery by the tumour, or with the raising up of peritoneum by a retroperitoneal growth. When the mesentery has been opened up *large blood-vessels* will be found between the peritoneum and the cyst wall.

Infected cysts.—It is very uncommon to meet with a tumour of large size whose contents have suppurated, that is, a tumour which was originally cystic and which has become infected later, but such cases are occasionally found. The infection in most cases spreads from the tubes, but ovarian tumours of low vitality may be infected from the bowel or through the blood stream. The association of appendicitis and ovarian abscess will be dealt with later. If the external appearance of the tumour indicates that its contents are probably purulent, and if it is very fixed in the pelvis, the question arises as to whether it is not better to deal with it by a process of marsupialization or by drainage *per vaginam.* In the former case the cyst should be tapped, the partially collapsed cyst pulled as far out of the incision as possible, the cannula removed, and the opening extended by scissors so that all the purulent contents can be evacuated. The edges of the cyst are then stitched to the edges of the skin and the cavity packed with gauze. This method is only occasionally required. As a rule it is possible to remove the suppurating cyst entirely. A true ovarian abscess, which is part of a process of infection spreading along the tubes, is much more common, but that will be dealt with under a later heading.

5. **Ovarian Cysts with Torsion of the Pedicle.**—As a rule operations in these cases present no great difficulty. Changes in the cyst wall, due to the twist, often lead to

adhesions, but these are usually very easily separable. The careful sweeping of the hand round the tumour is sufficient to detach them. The cyst is, in some cases, very deeply injected and rather friable, in other cases the cyst wall is of a dull yellow colour and leathery consistence. In most cases the cyst has to be carefully handled, and this care must be still more marked as the pedicle is reached. In some cases the pedicle is so thin that anything like rough handling will detach the cyst.

6. Thin-walled Cysts with Colloid Contents : Pseudo-Myxoma.—It is almost impossible to remove these neatly and without rupture. The glue-like contents become scattered over the abdominal cavity and the intestines. As a rule this material has to be removed in handfuls or with large swabs or soft towels. It is well to get the greater portion of it away. The pouch of Douglas must be carefully cleaned out, also the pouches at each side of the spine in the lumbar region, but it is not necessary to be very scrupulous in removing every particle. It is possible that as a result of the spreading about of this colloid material, adhesions may occur later on, but as a rule no trouble follows, even if a considerable amount of the thick fluid is left behind. In this connection we may also refer to the masses of lymph which occur in the peritoneal cavity as the result of irritative changes, due to rupture of an ovarian cyst. These masses of lymph are seen in distinct yellow or whitish layers, adherent to the parietal peritoneum, or to the various pelvic organs, or to the intestines. These layers are sometimes very adherent, and any attempt to strip them off leads to punctate haemorrhage. It is better, therefore, not to try to remove them. No harm as a rule comes from leaving them undisturbed.

Vaginal ovariotomy will be dealt with later in the Article on Vaginal Coeliotomy (see p. 620).

Accidents during the Operation

1. Haemorrhage.—Profuse haemorrhage during the operation of ovariotomy is rare, but troublesome haemorrhage may occur (1) as a haematoma; (2) as punctate haemorrhage caused by separating the cyst from the abdominal wall; (3) as venous oozing from separation of adhesions in the pouch of Douglas or to the rectum, mesentery, or omentum; (4) in folds of the broad ligament after enucleation of the cyst. Very profuse venous haemorrhage may occur, with tearing of the internal iliac or common iliac vein if the retroperitoneal portion of the tumour is forcibly dragged upwards, but such an accident should not occur if the situation of the tumour is realized. The usual methods of controlling venous haemorrhage by pressure, under-running, or ligature are generally successful.

The method of controlling oozing from a cavity left after enucleation of a broad-ligament tumour by closing the cavity with buried stage sutures has already been mentioned. A haematoma of the broad ligament is of rare occurrence, if the pedicle is first of all clamped by forceps and the forceps tied off after removal of the tumour. It is generally due to the puncture of a vessel, but may be caused by the retraction of a vessel from its encircling ligature. It shows itself as a dark blue swelling which gradually spreads under the peritoneum. The peritoneum may be stripped from the bladder by the haemorrhage. The most likely as well as the most troublesome site of a haematoma is at the infundibulo-pelvic fold, close to the caecum or sigmoid, and it may cause the peritoneum to be stripped from the bowel. When a haematoma makes its appearance the peritoneum over it should be split up, the clot squeezed out, and the bleeding point grasped by forceps, and ligatured or under-run. When a cyst has been stripped from the parietal peritoneum over a large area, there is sometimes a good deal of oozing at numerous points. Just before closing the abdomen this raw area should be carefully inspected. As a rule, after exposure to the air and after mopping with swabs, it will be found that the haemorrhage ceases, but occasionally there remain one or more persistent points of haemorrhage. In such cases it is well to under-run these points. There is little chance of any serious consequences from this kind of haemorrhage, but the formation of a layer of blood-clot on the parietal peritoneum always predisposes to adhesion of intestine at a later stage.

2. **Injuries to Intestines.**—The bowel may be torn or injured at any part of its course as the result of separating adhesions. The extent of the injury is usually not very severe. It is generally sufficient to close over the rent by stitching with fine silk with two or three rows of sutures. Extensive laceration of the intestine may be met with in cases of pelvic abscess, and in these cases it is sometimes necessary to perform anastomosis after excision of the injured ends. The rectum may be rather severely torn on removal of a pelvic tumour, but here again anastomosis is rarely necessary as one can usually repair the rent by stitching in two or three layers. In these cases it is a good plan to make a counter opening for drainage through the pouch of Douglas into the posterior vaginal fornix. A roll of gauze can then be passed from the pelvis into the vagina. In the event of a leakage from the bowel occurring there is then less likelihood of acute peritonitis.[1]

3. **Injuries to Bladder.**—These are comparatively rare during the progress of an ovariotomy. It may happen that, owing to the intraligamentary development of an ovarian tumour, the bladder may be raised high up on the anterior abdominal wall, and if the operator is a little careless the bladder may be opened at the time of making

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[1] This subject is more fully dealt with in the Article on Intestinal Complications, etc. (p. 555).—EDITORS.

the abdominal incision. It may also be injured during the process of enucleating an intraligamentary cyst. The injury is generally easily recognized at the time, and is also easily repaired.

4. Injuries to the Ureter.—It has been noted that in the cases of intraligamentous or retroperitoneal cysts the ureter may be exposed, even to the extent of some inches. It is very rarely injured, however, in these cases. The repair of injuries to the ureter is fully described in the Article on Hysterectomy (p. 447).

5. Incomplete Ovariotomy.—It is very rarely now that one meets with a tumour which cannot be removed entirely, except in malignant cases. But now and again we may find a thin-walled cyst dipping deeply into the cellular tissue of the pelvis between the folds of broad ligament. And it is sometimes the wisest course not to attempt to remove the deepest portion of the cyst wall if it is a unilocular cyst.

Operations for Tubo-Ovarian Inflammation

In operating for these conditions we find clinically two kinds of case. In the one there are adhesions, but no suppuration. In the other there is an abscess of the tube or ovary, accompanied by adhesive inflammation.

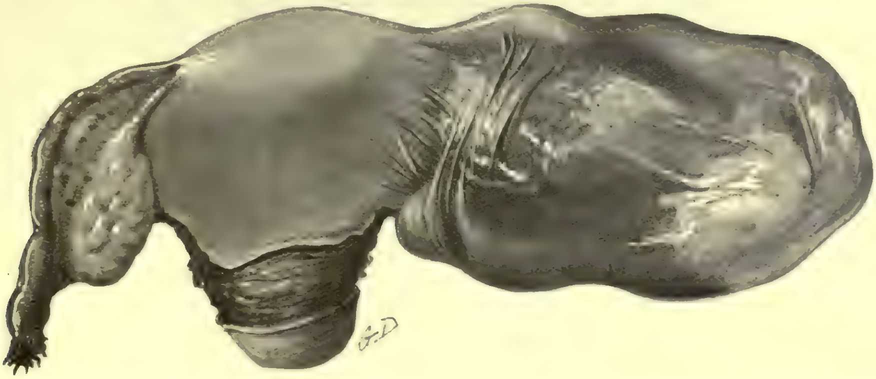

FIG. 142.—Specimen of cystic ovary and occluded Fallopian tube, the result of inflammatory processes.

1. Non-Suppurative Cases.—The conditions found in these vary greatly. Sometimes one or both tubes are distended with clear fluid. The condition is generally bilateral, but one side is usually more affected than the other (Fig. 142). A hydrosalpinx may be fairly free from adhesions and easily lifted out of the pelvis, and the ovary may be quite distinct. At other times we find very firm adhesions. The intestines are not often involved in these, but the tube is generally fixed in the pelvis to the back of the broad ligament and to the pouch of Douglas. In some cases the ovary is also cystic (Figs. 143, 144, and 145), and occasionally the tube and ovary are fused together and a tubo-ovarian cyst is formed. In these cases ovarian tissue can generally be seen flattened out on the cyst wall. A hydrosalpinx or tubo-ovarian cyst may attain a very large size. In other cases there is little or no distension of the tube, but the effects of inflammation are shown by thickening of its walls. In other cases, again, the changes in the tube and ovary may appear to be comparatively slight, but the whole of the pelvic organs are fixed by a general adhesive process. Sometimes the uterus is bound down in the position of retroflexion.

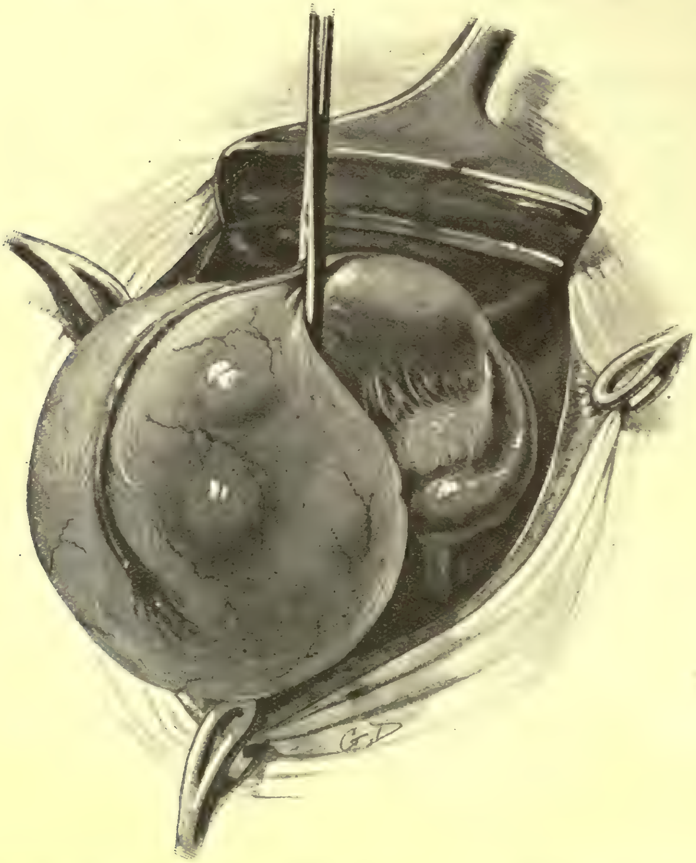

Fig. 143.—The ovarian cyst is drawn out of the abdomen and the Fallopian tube clamped with forceps. The retractor has been introduced.

Operation in these cases is generally attended with only a slight mortality. The chief difficulty met with is the density of adhesions the separation of which is often troublesome, but on the other hand it is not common to have intestines very firmly adherent, and more important still, the cases are non-infective. As we can never be quite certain, however, that there is no pus present in cases where we have adhesive peritonitis, we must always operate with the same precautions as if we were dealing with a suppurative case. Further, it is in these cases that the conservative operations on the tubes and ovaries have a very distinct place, and we have always to consider whether it is necessary to sacrifice a tube or ovary, or whether it is not sufficient to separate adhesions and excise portions of the diseased organs. The conservative treatment of tubal and ovarian disease will be dealt with later (see p. 431).

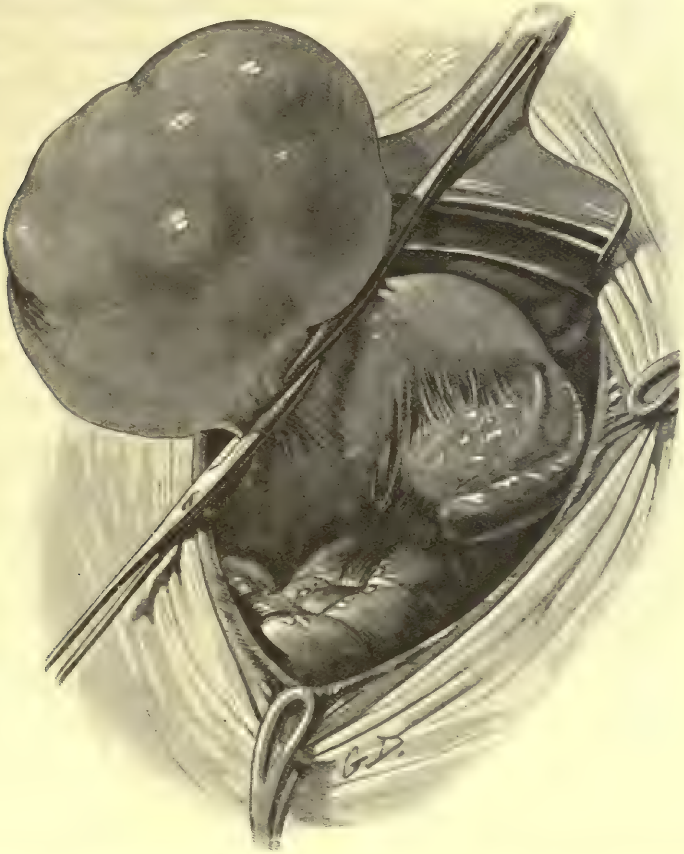

FIG. 144.—Shows the ovarian pedicle clamped. The tube and ovary of the other side are seen to be adherent to the uterus.

2. Infective Inflammation.—Operations in this class of case are amongst the most difficult and dangerous of gynaecological operations. The chief danger is the spread of infection to the general peritoneum as the result of liberating pus which has been shut off by inflammatory processes. Secondly, there is always great liability to injury of the bowel. The first risk fortunately is not present in every case of purulent inflammation, as in a fairly large proportion of cases the pus is found to be sterile. The adhesions in these inflammatory cases are generally widespread and firm, and the tissues affected are so disorganized by the action of germs that if the bowel is involved it is very easily torn. In most cases, indeed, it will give way when only a moderate amount of traction is employed.

The Operation.—The same preliminary precautions are taken, and the same aseptic details observed as in the operation for ovarian tumour already described. The incision required is of moderate length only, not reaching to the umbilicus. The abdominal wall is generally found to be very vascular in these inflammatory cases, and a good many bleeding points must be seized with pressure forceps. The peritoneum must be opened very carefully as bowel may be adherent immediately under the incision. In many cases, when the peritoneum has been opened, the omentum will be found underneath adherent to pelvic structures. This should be tied off and divided with or without previous clamping. The retractor is then inserted in the lower angle of the incision and an exaggerated Trendelenberg position obtained (see Fig. 78, p. 316), and the intestines carefully raised out of the pelvis. Some portion of the small intestine is often found to be adherent. Such coils of bowel as fall to the upper part of the abdomen are carefully packed away with the roll of gauze, so that only the actual field of operation is visible, and no portion of intestine is visible, except such as is adherent to the pelvis. This packing must be cautiously done, so that no undue traction is exerted on the adherent bowel. A careful inspection of the pelvis must then be made (Fig. 145). In some cases, even of infective origin, the dilated tubes may be almost free in the pelvis, but on the other hand one often meets with cases in which the pelvic organs are almost completely hidden from view by adherent intestine.

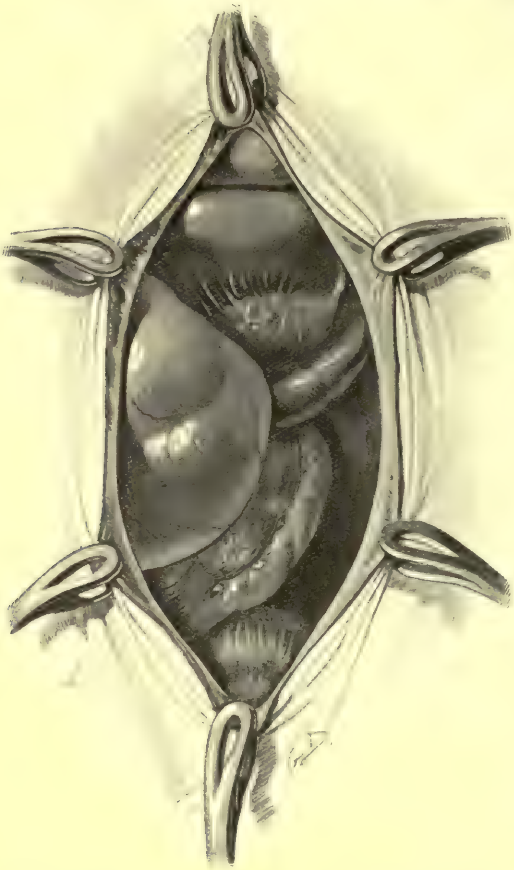

Fig. 145.—The abdomen has been opened and tetra-cloths clipped to peritoneum. The patient is in the Trendelenberg position. On the left is seen a small ovarian cyst; from above downwards are seen the fundus of the uterus, adherent right ovary, and occluded Fallopian tube.

It may even happen that the intestines are so firmly and so uniformly adherent as to make it impossible to reach the pelvic organs without very serious danger to the patient.

When intestinal adhesions are present the first step is to deal with these. For reasons already given great care must be used in handling the bowel. The adhesions must be divided with scissors, and the operator must always see what he is doing. Gentle traction must be made on the bowel, and the adhesions divided as far away from the bowel wall as is possible (Fig. 146). Any attempt at separation by sponging or swabbing with gauze, or by pulling on the inflamed organs and separating with the fingers, is dangerous. Occasionally coils of bowel may be separated by gently pinching the adherent portions with the finger and thumb in the line of union, but this is a manipulation which is only occasionally useful, and which requires a good deal of experience. The bowel must always be surrounded with gauze, and if any faecal matter escape it must be carefully mopped away with small swabs which are only to be used once. It is nearly always possible to repair the rent by stitching with fine silk, and two or three rows of sutures should be used. In very rare cases the repair involves the great part of the circumference of the bowel, and an anastomosis of intestine after resection may have to be made.[1] Sometimes quite a considerable portion of the bowel may have to be excised, on account of the unhealthy condition of the adherent and inflamed portion, which makes accurate stitching very difficult.

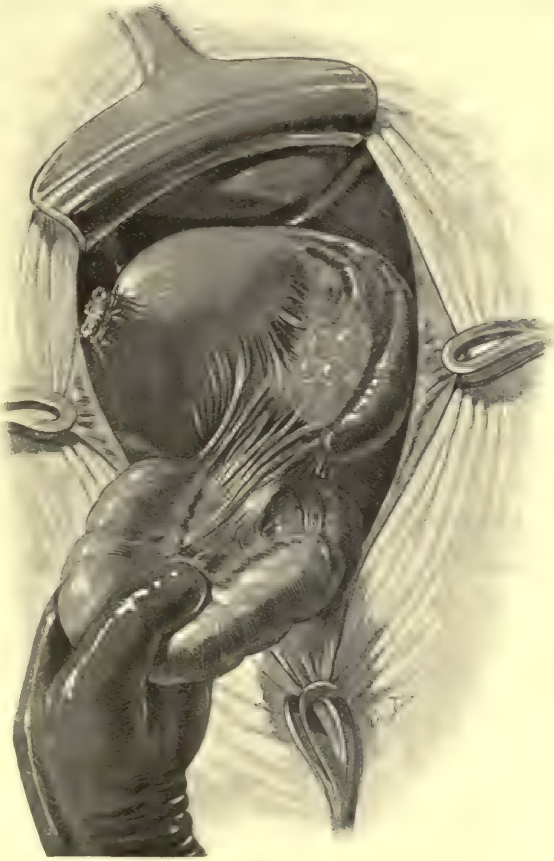

FIG. 146.—Shows adhesions of the pelvic colon to the uterus and right ovary.

When the intestinal adhesions have been dealt with, the coils which have been separated are gently pushed towards the upper part of the abdomen and packed off with gauze. The pelvic organs are once more inspected and carefully palpated in order to ascertain their exact relations. We must first ascertain the position of the uterus and from that we can trace out the appendages on each side. The inflamed tube is generally found to run in a tortuous manner outwards, and then dip downwards to the back of its broad ligament, and into the pouch of Douglas. If the adhesions are not very firm, the hand should be passed carefully down behind the distended tube. In some cases it is possible, straight away, to lift up the inflamed appendages from the pouch of Douglas and the posterior aspect of the broad ligament without any risk of tearing important structures. This is the method which should be adopted in non-infective inflammatory cases. It is hardly necessary to say that such enucleation must be performed from behind and from below.

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[1] See also Article on Intestinal Complications, etc. (p. 555).

If there is much distension of the tube or ovary, and pus is likely to be present, there is always the danger, whenever the appendages are lifted up in this way, of tearing into the abscess cavity, an accident which one must use every care to prevent. In these cases the best plan is to proceed cautiously from above downwards. The uterine end of the tube is clamped and the upper part of the broad ligament divided with scissors on the outer side of the forceps. If the tube contains pus it is best to put two pressure forceps on the uterine end and divide the tube between them, so that the pus may not be squeezed out. The infundibulo-pelvic fold is also clamped and the tube separated from its outer attachment. The ovarian ligament is, as a rule, not easily differentiated in these cases, but if it is found it should also be clamped with forceps and cut.[1]

As a result of these procedures the inflamed appendages are more easily got at. If possible all adhesions must be brought into view and separated by scissors, but this is not always practicable, and in many cases enucleation has to be completed by the sense of touch.

The part of the tube which is most apt to give way is the abdominal end, where it is adherent to the pouch of Douglas, and the greatest care must be exercised when we reach the lowest part. In some cases the abdominal ostium of the tube is only closed by peritonitic adhesions, and therefore it is bound to rupture when we separate that point. In view of the possibility of this rupture the packing off of tube and ovary must be very thorough, and an assistant must be ready to restore the table to the horizontal as quickly as possible, otherwise the escaped pus may find its way to the upper part of the abdomen. It is in this connection that the great advantage is shown of a table which can be rapidly and easily altered from the Trendelenberg to the flat position by the anaesthetist alone.

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[1] Other methods of dealing with such cases are discussed in the Article on Inflammation of the Fallopian Tubes (Vol. I. p. 623).—EDITORS.

Another risk in separating the part of the tube or ovary that lies deepest in the pelvis is injury to the rectum. Rectal adhesions are not uncommon. The bowel may be easily torn if great care is not exercised. Coils of small intestine are sometimes found adherent in the true pelvis. Sometimes there is a U-shaped loop, the lower end and sides of which are firmly adherent to the surrounding structures, while the two limbs of the U are adherent to one another. It is best to release the whole coil carefully and then to separate the two limbs from each other. This is sometimes best done by steadily nipping the line of union between the finger and thumb.

If the abscess ruptures during the separation, the escaping pus must be mopped out with swabs with the patient in the horizontal position. The swabs must only be used once and then put aside. Once the rupture has occurred a little more force may be used in enucleating the inflamed appendages and bringing them out of the pelvis, so long as we avoid tearing the small intestines or rectum. When the appendages have been released the portions of broad ligament between the forceps which were first applied are clamped, and the inflamed structures cut away. The forceps are then tied off with catgut (Fig. 147). In dealing with the uterine end of the tube when it is thickened and obviously inflamed right up to its point of origin in the uterus, some operators remove it by a wedge-shaped incision which runs into the uterine wall and which is closed by stitching the peritoneum over, so as to obliterate the uterine ostium. The cavity from which the inflamed mass has been removed must now be carefully cleansed, and the patient may then be returned to the Trendelenberg position. The appendages on the other side must be attended to if they have not already been dealt with, and if they are also inflamed. The steps to be taken when the rectum is injured have been already described under ovariotomy.

Drainage.—The question of drainage is of the greatest importance in tubal and ovarian abscesses. In some cases the pus contained in a pyosalpinx or ovarian abscess is so highly infective that the omission of drainage may mean a fatal result. On the other hand it is often sterile, and the adoption of drainage makes a somewhat uncomfortable and often delayed convalescence. The cases which are most likely to be infective are those in which the cause of the inflammation has been septic infection following a confinement or abortion, and those in which the tube or ovary has been infected by an inflamed appendix. In tubercular and gonorrhoeal abscesses of tube and ovary it is not so dangerous to close without drainage if the tubes are not bound down firmly by adhesions. The difficulty in these cases is that there is often a mixed infection which gives rise to firm adhesions. We have some indications from the general condition of the patient. If she has a rapid pulse and high temperature, or even a frequent rise above 100°, the chances are that the pus is infective.

If the patient has never been acutely ill, and has merely suffered from want of energy or backache, with only a slight rise of pulse and temperature at the menstrual period, it is generally safe to omit drainage. When the pus which escapes has a very offensive odour this is not an indication for drainage, in fact some operators regard it as a favourable sign. As a general rule, however, if there is any doubt about the case, it is best to drain. Apart from the question of infection, gauze packing and drainage may be advisable as a means of checking oozing from raw surfaces in the pelvis.

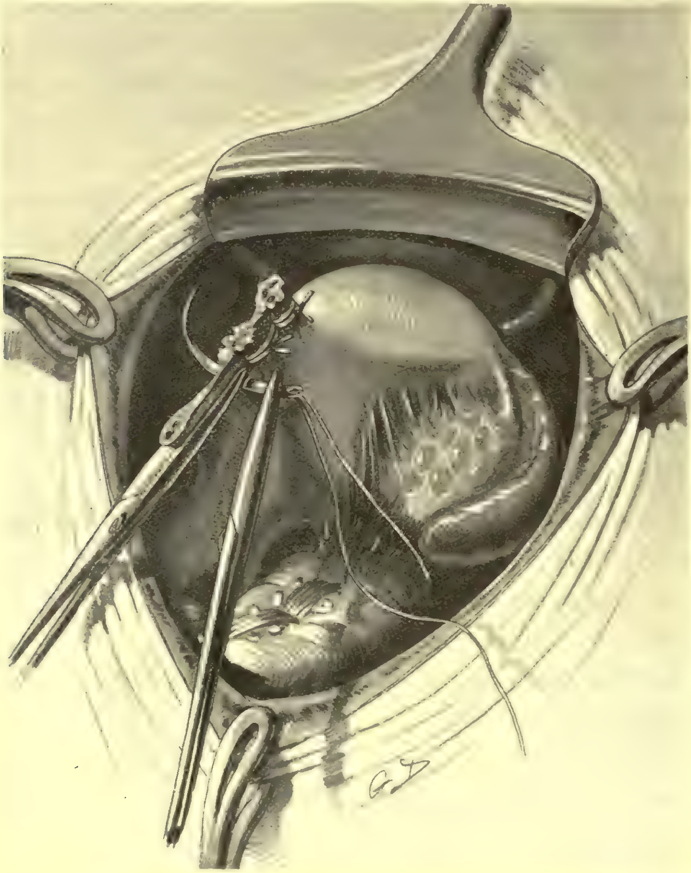

FIG. 147.—The left broad ligament has been partially ligatured after removal of the cyst.

Drainage may be secured either through the abdominal incision or by the vagina. If it is decided to drain by the abdomen a glass drainage tube should be used, at least for the first few days, after which a rubber tube may be used. But as a rule drainage by the vagina is better. When this is decided upon, an assistant pushes a long moderately-curved forceps up into the posterior vaginal fornix until the operator can feel the elevation in the pouch of Douglas caused by the point of the forceps.

He then cuts down on this point until the assistant can push it into the pelvic cavity.[1] The forceps should then be opened, so as to stretch the opening in the vaginal vault. The end of a long piece of gauze is then put into the forceps, which is then withdrawn, pulling the end of gauze through the opening and out of the vulva. The abdominal end of the gauze is then packed loosely into the true pelvis, and when sufficient has been used, the superfluous part is cut away. If there is rather free oozing from raw surfaces, but not so free as to require ligature or under-running, the gauze must be packed fairly tightly. It is an advantage to shut off the gauze partially or completely from the abdominal cavity. This may be done by bringing the outer end of the broad ligament transversely across to the uterine end, or the serous coat of the rectum may be stitched to the peritoneum covering the back of the uterus, or to the broad ligament. This procedure prevents coils of intestine from falling into the true pelvis and so becoming adherent to the gauze.

In cases in which the tube and ovaries on both sides are hopelessly disorganized by abscess formation, and where it is necessary to remove the appendages on both sides, it is generally better to make a ‘ clean sweep ’ and to remove the uterus as well. It is possible there is still some purely sentimental objection to this method, but a uterus deprived of its appendages is a useless organ. There is no doubt that in most of these bad cases the radical operation is the safest. Not only is the uterus useless, but it may act as a source of re-infection. Further, the radical operation is often easier to carry out than removal of the appendages only, when everything is bound down in a mass of firm adhesions. Starting at the outer side of one broad ligament, the infundibulo-pelvic fold is caught in pressure forceps, and the broad ligament is divided on the inner side of the forceps. This generally enables one to apply another pair of forceps to the lower part of the broad ligament and divide it farther down. In this way we may more readily get below and to the outer side of the adherent appendages, so as to release them from their adhesions. When one side is free the other side is more easily dealt with. The uterus may be amputated at the external os, but the better plan is to perform panhysterectomy and remove the cervix. The aperture left at the top of the vagina serves for free drainage, which should be secured in the manner described. A stitch may be of use on each side to bring the cut vaginal walls partly together at each angle, if the opening seems too wide, and the gauze may be shut off above by fixing the peritoneum of the pouch of Douglas to the peritoneum attached to the bladder. If it has been decided to amputate the uterus at the internal os, the pelvis may be drained through the pouch of Douglas. Some operators remove the tube only on one side, the tube and ovary on the other, and at the same time remove the fundus of the uterus by a wedge-shaped incision. The uterine stump, which includes some of the endometrium, is then closed by antero-posterior stitches and the anterior and posterior peritoneal coat brought together by a continuous suture. It is said that by saving one ovary and some of the endometrium menstruation continues, and that the patient is more comfortable afterwards. I shall refer to this point later.

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[1] See also Article on Technique (p. 283).—Editors.

Rarer Forms of Pelvic Suppuration.—In some cases we find that the abscess is not confined to the tube or ovary, but is actually in the pouch of Douglas or other parts of the pelvic cavity. These are shut off by the adhesions of the pelvic organs, or even by coils of bowel. The majority of these cases are tubercular in origin, but sometimes they have their origin in an acute septic infection, following labour or miscarriage.

The multiple *tubercular* abscesses are generally found in what may be called acute or sub-acute cases. In these the peritoneal surfaces of the affected parts are generally highly injected, often covered with miliary tubercle. The tissues are generally easily torn. Both on this account and because the patients are in a weak and exhausted condition, the results of operation are unfavourable. In some of the bad cases it may be found quite impossible to remove anything, and one may have to be satisfied to open these collections of pus and drain with tubes or gauze from the abdomen.

In the *puerperal* septic cases multiple abscesses may be formed by leakage from the tube. If there is pus in the pouch of Douglas, it is best to evacuate it by an incision in the posterior vaginal fornix. Other collections of pus may be exposed by separating adherent coils of bowel. After the pus has been swabbed out as carefully and thoroughly as possible, the cavities should be drained, either by a tube or tubes in the abdominal incision or into the vagina by gauze. Occasionally both abdominal and vaginal drainage is necessary in the same case, and occasionally one finds an abscess in the folds of the broad ligament, as the result of a parametritis, associated with tubal or ovarian abscess. This should be opened extraperitoneally by an abdominal incision just over Poupart's ligament or through the anterior fornix of the vagina. The former route is chosen when the inflammatory swelling is in the outer part of the broad ligament and can be felt above Poupart's ligament, and the latter when the swelling is in the inner and lower part of the broad ligament. When the vaginal route is chosen, the anterior fornix should be incised, and the bladder stripped up from the anterior surface of the uterus. The finger should then be swept outwards towards the affected broad ligament until the swelling is felt. A long forceps should then be pushed into the swelling, and if pus escapes the blades should be opened so as to give free access to the abscess cavity, which must then be packed with gauze.

The association of appendicitis and inflammation of the uterine appendages is fairly common in the chronic form. An appendicular abscess may be found tracking down into the true pelvis, and may even point in the pouch of Douglas or rupture into the rectum or bladder. It may exist alone or may be associated with a tubal or ovarian abscess. There is no doubt that the tube or ovary may be infected from the appendix, but my own experience leads me to the conclusion that such an accident is not nearly so common as some observers believe. The appendix may be glued to ovary, tube, or uterus by a peritonitic process spreading from the appendix or from the pelvic organs, and there may be pus in the uterine appendages or in the appendix, but it is rare to find it in both. When it does occur it means that the tube has previously been blocked and distended, or that there has been a cystic tumour or haemorrhage in the ovary. As might be expected, one finds an ovarian abscess much more frequently associated with the appendix than a tubal abscess.

Conservative Operations on the Tubes and Ovaries

These are chiefly indicated in cases of non-suppurative inflammation, where the tubes are closed at the abdominal end, and where the ovaries are the seat of small unilocular cysts. It is not necessary to remove appendages for these conditions. All adhesions should be separated, and in the case of ‘ blind ’ tubes, an artificial ostium may be made. The tube is opened near its abdominal end with a knife, and the mucous membrane is stitched to the peritoneal covering, so as to preserve the opening.[1] It is probable that in most cases the mischief has been sufficient to make the chance of subsequent pregnancy very slender, but cases have been recorded in which this has happened after an artificial ostium has been made. Single cysts in the ovary, even of the size of a walnut, may be excised, and the healthy part of the organ left (Fig. 148). There is generally very free oozing from the ovary after excision of a cyst, and this necessitates the insertion of several catgut sutures, or better still a continuous suture running the whole length of the incision.

A good deal of judgment is required in deciding between the radical and conservative treatment of an ovary. In the case of women who are of the child-bearing age, it is better to leave some ovarian tissue, even at the risk of having to remove the ovary later on. When both ovaries are diseased, and one has to be sacrificed, every effort should be made to save some part of healthy tissue in the other ovary. In cases where the tendency of the ovary is to drop into the pouch of Douglas, *prolapsed ovary*, it is a good plan to fix it by a few stitches to the infundibulo-pelvic fold of the broad ligament. In parovarian cysts, where the ovary can be separated and is apparently healthy, the cyst should be enucleated through an incision in the peritoneal covering. There is no need to remove either the tube or the ovary.

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[1] This procedure is illustrated in the Articles dealing with Sterility (Vol. I. p. 411), and Inflammation of the Fallopian Tubes (Vol. I. p. 636).—Editors.

The conservative treatment is a much more difficult problem in suppurative cases. In these the chances of permanent damage—as far as future pregnancy is concerned—are much greater than in non-infective cases. Further, there is always a risk of leaving behind a focus of infection which may cause serious trouble either directly after the operation or at a more remote period. As a rule we find in infective cases that both tubes contain pus, although one may be much larger than the other, and in these it is wisest to remove both tubes. The conservative treatment in these cases is apt to be disappointing. But occasionally one finds that the mischief seems to be entirely, or almost entirely, unilateral. In two cases which came under my care quite recently, I found that there was a large pyosalpinx on one side, while the other tube seemed hardly affected, the abdominal end being patulous and free from adhesions. In both of these cases the comparatively healthy tube with the corresponding ovary was left, and both patients made a good recovery. One patient about ten days after the operation had a sharp attack of pain in the side, corresponding to the tube which was left, and the temperature ran up to 102°, but the attack subsided in twenty-four hours, and the convalescence afterwards was rapid. The second patient had a smooth and uninterrupted convalescence. These cases, however, are exceptional.

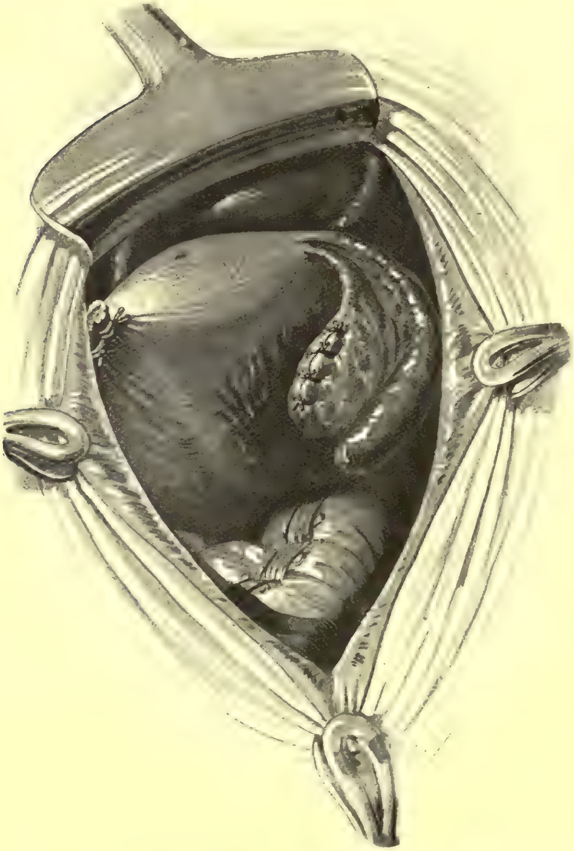

FIG. 148.—The adhesions to the uterus and right ovary have been separated and the cystic portion of the ovary resected.

Some operators lay great stress on the importance of leaving one ovary or part of an ovary, even when both tubes have been removed, on the ground that the patient is less likely to suffer from serious troubles which they believe to be common in an artificially induced menopause. My own experience leads me to believe that the risk of these troubles occurring has been greatly exaggerated, and my practice in cases of double pyosalpinx is to remove both ovaries along with the tubes, and in bad cases to remove the uterus as well.

There are some cases in which it is good practice merely to incise and drain a tubal or ovarian abscess, and not to remove it. This can only be done with safety from the vagina. It would obviously be a dangerous procedure to do it from the abdomen. But if, in an infective case, we find on vaginal examination a fluctuant or tense swelling in the pouch of Douglas, we may incise it through the posterior fornix.[1] Sometimes the pus which escapes does not come from the tube or ovary, but has been collected in the pouch of Douglas and shut off from above by adhesions. After draining and washing out with a gentle stream of sterilized water, we may explore further by pushing the finger through the vaginal incision. If we can feel a distended tube or ovary, and are quite sure of the condition, we may push the end of a forceps into this second swelling, and in this way evacuate a tubal or ovarian abscess. It is safer, however (except in abscesses which bulge the pouch of Douglas), to make a preliminary abdominal section, so as to be quite sure of the organs with which we are dealing. It may then be found that vaginal incision and drainage by gauze is the best means of dealing with the abscess.

It is extraordinary how, in the course of time, the effects of the surrounding inflammation clear up after these measures. In some cases I have found appendages which, at the time of operation, were thickened and fixed by adhesions, apparently quite free and normal in size some months afterwards. It is improbable, however, that their *function* is ever restored.

Operations for Septic Conditions during the Puerperium

These may be divided into (1) acute general septic peritonitis, (2) subacute septic peritonitis with localized abscess formation, (3) thrombo-phlebitis.

1. **Acute Peritonitis.**—In the early days of abdominal section, much was hoped for from the introduction of surgical methods in dealing with acute septic conditions during the puerperium. But these hopes were not realized, and even to-day we are comparatively helpless during the acute stages of these conditions. In the very acute cases death ensues in a few days, before there are any marked changes to be found in the pelvic or abdominal organs. The channels by which the septic organisms

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[1] See Article on Vaginal Coeliotomy (p. 608).

spread are (*a*) lymphatics, (*b*) blood-vessels, and (*c*) direct continuity of tissues. In acute cases all these channels are employed and the infection is widespread. The mere opening of the abdomen does no good ; the operation may add to the discomfort of the patient. Incision of the posterior fornix and even removal of the uterus *per vaginam* have been recommended, but have been abandoned by most.

2. **Subacute Peritonitis.**—In cases in which the resisting power of the patient has been sufficient to carry her through the early stages of an acute attack, or where the virulence of the sepsis has not been so great, Nature attempts to limit the ravages of the organisms by setting up inflammation-barriers. In this way we get the formation of localized abscesses. The operative treatment of these cases has been already described. It is not always easy to decide as to when we should operate. As a general rule it is best to wait for some time. The advantages of waiting are : (*a*) the abscess or abscesses are as a rule better shut off from the general peritoneal cavity, and there is not so much risk of leakage of pus into this cavity; (*b*) in many cases the pathogenic organisms after a time gradually die out ; (*c*) there is often a marked improvement in the general condition of the patient, and also a local improvement in the abdominal conditions above the limiting inflammatory zone.

On the other hand the formation of an abscess may not be followed by improvement in the general condition, but the rise in temperature, the quickening of the pulse, and the deterioration in health may continue, and the patient be gradually worn out in the course of the illness ; or the abscess may develop rapidly, and if not opened may rupture into the abdominal cavity and set up an acute and rapidly fatal peritonitis. While, therefore, it is generally advisable to wait, the patient should be kept under careful supervision, and if there seems to be no improvement in the general condition, or if there should be a sudden acute change, operation may have to be undertaken as a last resource. The formation of an abscess is generally indicated locally by the formation of a definite mass in the pelvis which can be felt *per vaginam* or bi-manually. In most cases the formation of an abscess is followed by a change in the general symptoms,—the temperature tends to become intermittent, falling at times to normal and rising at other times to 102° or more. It is sometimes possible to diagnose the intraperitoneal rupture of an abscess, and then the only thing to do is to open the abdomen with as little loss of time as possible, wash out the escaped pus with saline solution, and drain either by the abdomen or the vagina, or by both.

3. **Thrombo-Phlebitis.**—This is a type of puerperal sepsis in which the main channels of infection are the pelvic veins. Whitridge Williams states that the lesions

of chronic pyaemia can be demonstrated in at least one-third of all autopsies upon women dying from puerperal infection. The history of surgical interference in this class of cases dates from papers published by Trendelenberg and Bumm quite independently in 1902, and since then a fair number of cases have been recorded. The results seem occasionally to have been encouraging and even remarkable. The chief difficulty is to decide as to the cases in which surgical treatment is advisable, and further, as to when the operation should be performed.

Symptoms and Diagnosis.—The symptoms may develop in a case which has been acute from the first, and in which the onset has occurred very soon after labour. In other cases they may occur about a week after labour, when there has been no previous marked pyrexia. The distinguishing features are repeated rigors with high temperature. During the rigor the temperature generally rises to 104° or higher, and in the intervals it may fall several degrees, but rarely to normal. This wide range of temperature in twenty-four hours is characteristic. The pulse rate rises with the temperature, and may be 120 or more during the rigor, falling afterwards to 100 or even 90. But a positive diagnosis of thrombosis of the ovarian or uterine veins can only be made when a worm-like mass can be felt in one or other broad ligament. In some instances no such swelling can be found and a positive diagnosis cannot be made. When the ovarian vein is affected this will be felt in the upper part of the ligament. When the internal iliac vein is involved the swelling will be felt in the lower part of the broad ligament, to the side of and rather posterior to the cervix. A thickened external iliac vein may be felt *per vaginam* well out on the lateral pelvic wall. It is stated that these swellings are associated with comparatively little pain or tenderness in pure thrombo-phlebitis. If the broad ligament is greatly thickened, so as to be felt as a well-marked mass, the chances are that the lymphatics and cellular tissue are involved along with the veins. As a rule the abdomen is fairly flat. If there is much abdominal distension there must always be a suspicion of some intercurrent septic peritonitis.

Indications for Operation.—If the symptoms clearly point to thrombo-phlebitis, and if a swelling can be felt in the broad ligament, the general opinion seems to be that an operation should be performed at once. But many of the operations performed early in the disease have proved unsuccessful, while on the other hand others that have been performed at a late stage appear to have been the starting-point of a rapid recovery. The danger incurred by waiting is the spread of the septic process higher up the veins, and the involvement of more veins. On the other hand, there is no doubt that some of the accompanying septic processes settle down if one waits for a time. In cases where the thrombo-phlebitis is associated with a lymphatic infection—cellulitic or peritonitic—it is sometimes wise to wait. In cases of more or less pure septic thrombo-phlebitis the safest plan is probably to operate as soon as the diagnosis is made if the attack is a severe one. A successful issue seems to depend more on the kind of case than the time of operation.

The results of operation are much better in chronic than in acute pyaemia, and consequently cases in which the onset of the symptoms is delayed for a week after labour are more favourable than those in which the symptoms appear in the first few days of the puerperium. Multiple pyaemic abscesses are a contra-indication, but cases have been reported in which patients have recovered after an operation performed after the onset of a septic pleurisy. But the onset of acute endocarditis or of a septic pneumonia indicates the spread of a thrombotic process beyond the reach of surgery.

We have already noted that the infection may spread both by lymphatics and by veins, and it is in these mixed cases that operation is likely to be disappointing. When one reads of cases in which the thrombotic veins and their surrounding tissues formed a large mass, it is evident that these were mixed cases, and that the outlook was unpromising.

General Remarks.—During the last year or two, the wave of enthusiasm for the operation seems to have subsided. The results of operation have shown little or no improvement over expectant treatment. In acute cases they are probably worse. Cases of the gravest character have been known to recover without operation even after the development of septic pneumonia and endocarditis. Many chronic cases have improved after operation, but these are just the cases that get well in time with expectant treatment.

There has been a good deal of hostile criticism even from those who at first welcomed the operation. The objections have been well summarized in a paper read by Palmer Findlay before the American Gynaecological Society in 1913, and in the discussion that followed. The main objections may be stated as follows :

1. " The difficulty in the making of an accurate diagnosis before opening the abdomen is, as yet, unsurmountable. It is not possible to judge with accuracy the extent of the infection within the veins or elsewhere after the abdomen is opened. We cannot rely upon the sense of touch to locate with certainty the presence or absence of pus within the veins. Failure to find bacteria in the general circulation gives no absolute assurance of the localized character of the infection, nor can a physical examination of the lungs and other viscera exclude the possible presence of metastatic foci " (Findlay).

Miller agreed that the chief disappointing feature had been the question of diagnosis. At one time he thought it would be an easy matter, but subsequent experience had shaken his confidence in his ability to select suitable cases for operation. He had not changed his opinion as to the value of the operation in pure septic thrombo-phlebitis, but he was now convinced that in order to make such a procedure of practical value we must discover other methods of diagnosis.

2. " It is a physical impossibility to ligate all the veins leading from the genital organs, and unless all channels are blocked there can be no assurance of checkmating the infection" (Findlay).

This difficulty was noted by Wallace of Liverpool, who reported a fatal case " as an illustration of the futility of closing up one set of exits from the thrombosed area." As soon as collateral venous channels became opened up, both toxins and emboli found their way into the general circulation with fatal consequences. It was doubtful whether even ligature of the inferior vena cava would have sufficed in his case, for the probability was that the toxic materials would still have continued to travel along whatever venous collaterals happened to become opened up.

In spite of all these criticisms there still appears to be a place for the operation. In a number of cases in which the disease has been running for weeks or months a rapid improvement has followed the operation. The conclusion seems to be, therefore, that it is of use in a certain type of case, but that the indications have yet to be more clearly ascertained. Experience so far seems to indicate the operation in cases of somewhat long standing, in which there seems to be no definite progress to recovery, and in which associated infection by lymph channels can be more or less excluded.

Technique of Operation.—The inflamed veins may be reached either by an extraperitoneal dissection, or by the intraperitoneal route. The former has several disadvantages, and has only been employed by a few operators. Its great disadvantage is that it is impossible to see which vessels are affected. If there is a doubt as to the condition of the vessels on both sides, an incision in both flanks will be necessary. The argument in favour of the extraperitoneal route is that peritonitis is less likely to happen, but this has not been borne out by experience. In this country and in America the intraperitoneal route has superseded the other, and the technique of this operation is the only one that need be described.

The abdomen is opened by a central incision with the patient in the Trendelenberg position, and the intestines packed off. The pelvis is then carefully explored, tubes and ovaries and broad ligaments being thoroughly palpated. The ovarian vessels should be followed up in the infundibulo-pelvic fold, and their course traced up higher. The deeper portion of the pelvis on its posterior and lateral aspect on each side should be examined, to ascertain if the internal iliac veins are involved, and the external iliac veins should also be examined. If any hardness is felt in any of these veins it may be assumed that there is thrombosis.

It seems now to be generally accepted that ligature of the veins is all that is necessary, and that excision, while adding to the difficulties, does not improve the result. If the ovarian vein is thrombosed the peritoneum covering it should be incised and a single catgut ligature applied well above the part that is felt to be thickened. The ligature may have to be placed high up at the cardiac end, just before it opens into the vena cava (right vein) or renal vein (left side). The divided peritoneum is then closed by a continuous catgut suture. It may be necessary to tie both ovarian veins. Some authorities believe that this is the utmost that should be done in any case. If this is all that is necessary the disturbance to the patient is not great, and the prognosis, as far as the operation is concerned, is good. But if the internal iliac vein is involved as well as the ovarian, many operators believe that this should also be tied. The dissection necessary in this case is much more extensive. The incision necessary to expose the ovarian vein is extended downwards, two fingers inserted into its lower end and passed down into the connective tissue along the pelvic brim. The iliac vessels are exposed by separating the fingers, and the manipulations are continued until the bifurcation of the common iliac is seen. The internal iliac vein is then ligatured close to its junction with the common iliac by means of a catgut ligature which is passed under the vein by an aneurism needle. The gap in the peritoneum of the broad ligament is then closed by a continuous suture.

Some authorities believe that all four vessels (two ovarian and two internal iliac) should be ligatured as a matter of routine, but this undoubtedly may mean a very formidable operation. Trendelenberg has even advocated the ligature of the inferior vena cava, but this procedure has not found much favour.

Ovariotomy and Pregnancy

The literature on this subject was well summarized by McKerron in his monograph, *Pregnancy, Labour, and Childbed with Ovarian Tumour*, published in 1903, and Marshall has published a synopsis of the more recent views.[1]

1. Ovarian Tumour and Pregnancy.—There is now general agreement that an ovarian tumour existing along with pregnancy subjects the patient to certain special risks, and that the proper treatment is to remove it during the pregnancy. There is some difference of opinion as to when it should be removed. Most authorities advise operation as soon as the tumour is discovered, irrespective of the duration of

[1] *Journal Obst. and Gyn. of the British Empire*, Feb. 1910.

the pregnancy, but others believe that it is better to wait till the pregnancy is well advanced, or even at full time, so as to give the child a better chance. There is, no doubt, some risk of abortion if ovariotomy is performed during the first six months. Recent statistics put this danger at from 10·3 to 19·4 per cent. Probably 15 per cent is a fair estimate. The risk of abortion is greater when both ovaries are removed, but the opinion that it is impossible for pregnancy to go on if both ovaries are removed during the early months, is certainly erroneous. A case has been recorded by Oldfield[1] in which bilateral ovarian cysts were removed during the third month of pregnancy, which nevertheless continued to term. On the whole it seems better to wait until the child is viable if a diagnosis of bilateral ovarian cyst is made during the early months, so long as the patient can be kept under observation.

As to the choice of operation, the abdominal route is usually employed in this country, although some Continental operators use the vaginal route for the removal of ovarian tumours during both pregnancy and labour. The disadvantages of the vaginal route are obvious :

(1) If the tumour contains any solid portion, or if small cysts are closely packed, the bulk of the tumour to be brought through the vaginal incision may be considerable ; (2) broad-ligament tumours may require enucleation, and this process during pregnancy may be followed by very profuse haemorrhage, difficult to control ; (3) adhesions to intestine or to other structures may be difficult to deal with ; (4) evacuation of the cyst is always necessary, and in the case of malignant growths this may lead to the implantation of cancer cells on raw surfaces ; (5) disturbance of the pregnant uterus may be very considerable.

The only objection to the abdominal route is that the scar may be subjected to considerable strain during the further growth of the uterus and during labour. For this reason some operators advise that the incision should be made over one rectus muscle, which should then be pulled outwards. But, so long as the wound is carefully stitched in layers, there is no great tendency to hernia.

Most of the cysts will be found in the abdomen at the side of the pregnant uterus, and can be delivered through the incision, just as in an ordinary ovariotomy (Figs. 149, 150, and 151). In exceptional cases the tumour may be beneath the uterus, impacted in the pouch of Douglas, or fixed by an intraligamentary development, and it may be necessary to bring the uterus out of the wound before it can be dealt with. In cases in which the child is viable, and where the tumour is adherent to the uterus, Caesarean section may be the best procedure after or before the removal of the tumour.

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[1] *Transactions North of England Obstet. and Gyn. Society,* 1913.

As regards the treatment of the pedicle, it is of the greatest importance that it should be tied in small sections, or that the vessels should be picked up and tied separately. I believe that the bunching together of the pedicle in a mass may act as a cause of abortion, since a strain may in that way be put upon the growing uterus. The uterus should be handled as little as possible, and should be protected by gauze wrung out of warm saline solution.

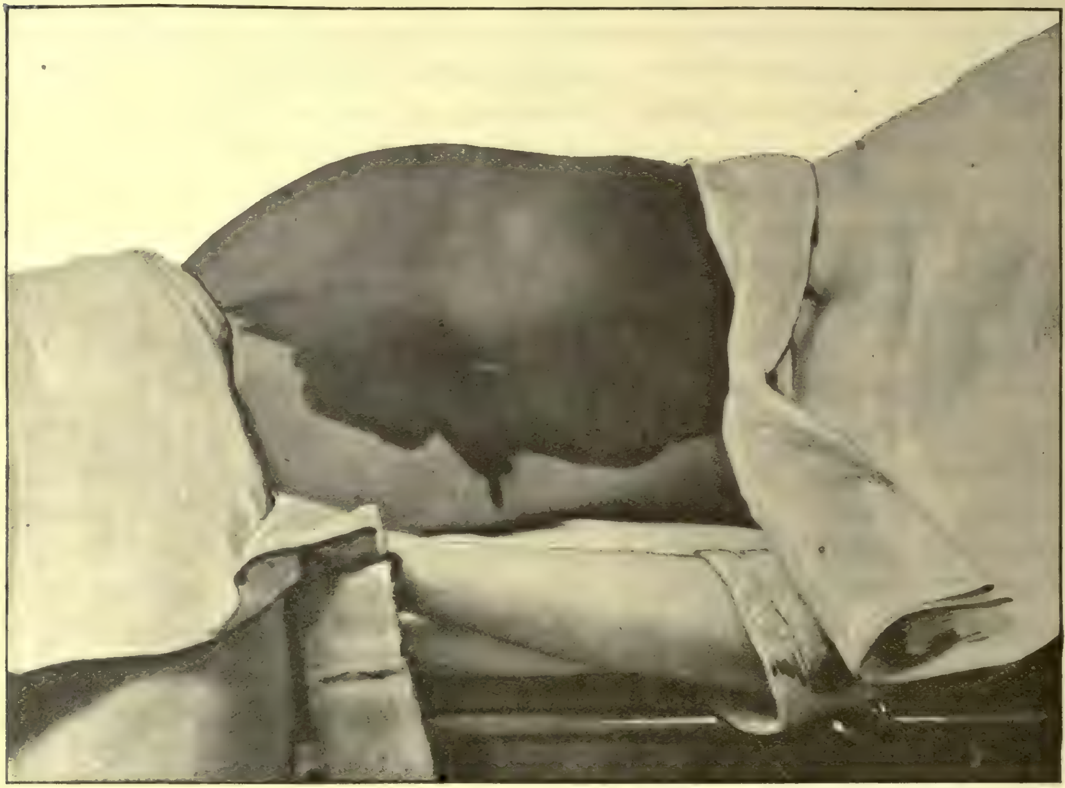

Fig. 149.—Profile of an ovarian tumour and a six-months pregnant uterus. The tumour lies on the patient's left and above the uterus. The skin is stained with iodine. (From a photograph.)

2. Ovarian Tumour and Labour.—When an ovarian tumour is discovered after labour has begun, the danger to mother and child is greater than when it has been diagnosed during pregnancy. It was very much greater under the older methods of treatment. The tumour is much more liable to be subjected to pressure, especially if it is pelvic or partially pelvic in position. It may cause serious delay in labour either by causing inertia or by direct obstruction. The various methods of treatment are as follows :

Expectant.—This is only applicable in cases in which the tumour is entirely abdominal. In the majority of these cases labour will be terminated by the natural powers. When there is delay in the second stage owing to the interference with the action of the voluntary muscles caused by the bulk of a large tumour, or inertia of the uterine muscle, delivery may be completed by forceps or version. During delivery the greatest care must be taken to avoid undue force. The possibility of rupturing or bruising the tumour must be borne in mind.

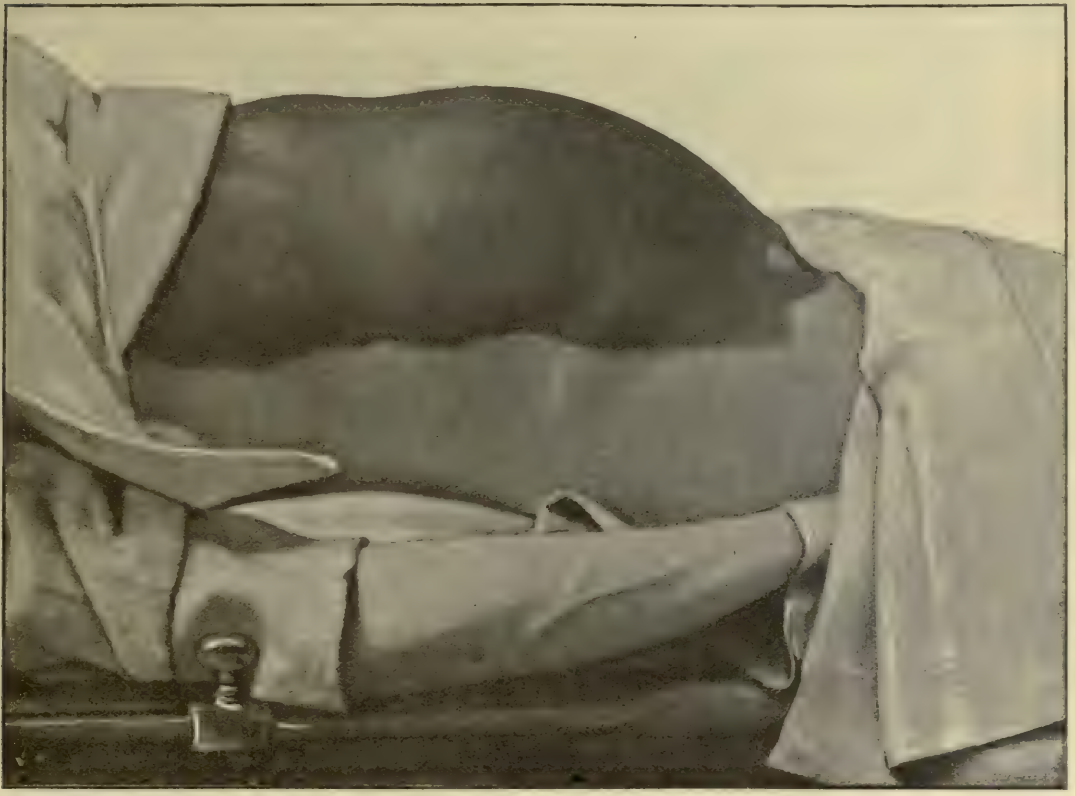

Fig. 150.—The same case as Fig. 149, from the other side.

The other methods apply chiefly to cases in which the tumour is pelvic in position.

Reposition.—It is sometimes found possible in the first stage of labour, or even at a later stage during the interval between pains, to push the tumour out of the pelvis, so as to allow the head to come down. If this can be accomplished easily with the aid of general anaesthesia and the Trendelenberg position it is probably the best treatment. But if there is much resistance it is best not to persevere. Even if one should succeed by the exercise of considerable force in dislodging the tumour, there is always the risk of rupture or of bruising. A tumour which has been damaged in this way is much more liable to the invasion of germs.

Tapping and Incision per vaginam.—This is not a method to be recommended except in cases of urgency, and where the circumstances or surroundings of the patient are unfavourable for other methods. There is always great risk of infection of the cyst and subsequent suppuration or adhesion.

Ovariotomy.—This is the method which under favourable circumstances should be chosen when the tumour cannot be easily pushed up. Experience has shown that it gives the best results. Abdominal ovariotomy is to be preferred to the vaginal operation, for reasons already mentioned. As the operation is generally undertaken for pelvic tumours, it is nearly always necessary to turn the uterus out of the incision, in order to reach the tumour. The pedicle must be tied in small portions after clamping, or the individual vessels may be seized and ligatured. Mass ligature is specially dangerous here, owing to the rapid diminution in the size of the uterus after delivery, and the dragging on the broad ligaments. After the tumour has been removed, the child may be delivered (*a*) by the natural powers, (*b*) by forceps or version, or (*c*) by Caesarean section. If the cervix is fully dilated and the head presents, it is best to complete delivery by forceps carefully used. Tate[1] has recommended that we should wait until the cervix is fully dilated before operating, so that labour may

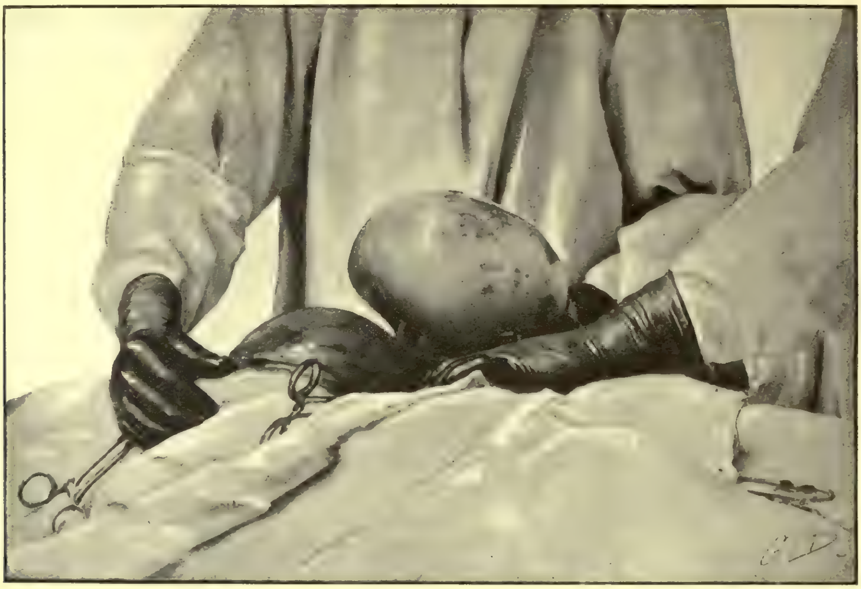

FIG. 151.—The tumour has been expressed from the abdomen through a long incision. The uterus is exposed and the pedicle of the tumour is shown. The tumour (a dermoid) springs from the right side although it lay on the left of the middle line. (From a photograph.)

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[1] *Royal Society Medicine* (*Obst. and Gyn. Sect.*), April 1911.

be completed while the patient is still under anaesthesia, and the abdominal wound sewn up more easily after delivery of the child. Version will only be necessary in the case of malpresentation. Caesarean section is rarely necessary, and is to be avoided if there have been prolonged manipulations, and if there is some doubt as to the aseptic precautions employed. It has to be employed in cases in which it is impossible without it to remove the tumour, as in intraligamentary cysts or cysts with firm adhesions. If there is a probability of infection during the previous conduct of the labour, a total hysterectomy with drainage into the vagina may have to be considered.

3. **Ovariotomy during the Puerperium.** — When it is known that an ovarian tumour exists during labour, it should be removed during the puerperium. If there are no symptoms and the tumour has not been exposed to pressure, one may wait for a week. But if we know that the tumour has been exposed to pressure during the labour, so that it has been bruised or possibly ruptured, or if there are symptoms of twisting of the pedicle, it is best to remove it immediately after labour or during the first few days of the puerperium.

Later Results of Ovariotomy

It is not necessary to mention all the later troubles which may arise as a result of ovariotomy, as most of these are common to all abdominal operations. We may, however, notice two of these later troubles.

Hernia in the scar may be due to want of care or thoroughness in stitching up the abdominal incision. But infection and suppuration of the wound will cause it, in spite of the most careful stitching. The use of a drainage tube leaves a weak spot in the lowest part of the scar, in which a hernia may develop. The length of the incision does not increase the risk of hernia, which nearly always occurs at the lowest part of the incision. Rapid accumulation of fat in the omentum may cause greatly increased intra-abdominal pressure, and patients in whom this happens are particularly prone to hernia. A troublesome cough also favours its occurrence, and any work or exercise which throws much strain on the abdominal muscles within a few months of the operation is dangerous.

The best preventives of hernia in the scar are rigid asepsis, the avoidance if possible of drainage, careful stitching of the abdominal wound in layers with special attention to the close approximation of the cut edges of the rectus fascia, and avoidance on the patient's part of anything which will strain the abdominal muscles for some months after the operation. There is some difference of opinion amongst surgeons about the use of an abdominal belt, but it seems a wise precaution for the patient to wear one for six months or a year after the operation.

Adhesions in the peritoneal cavity may cause trouble within a few weeks of the operation, or after a long interval. They seem to occur in some patients much more readily than in others. Predisposing causes are the leaving of raw surfaces uncovered by peritoneum, the escape of irritating ovarian or other fluid during the operation, and defective asepsis. The parietal peritoneum is a favourite site for adhesions. If a second operation is necessary at a later date a fold of omentum or coils of intestine may be found fixed underneath the old incision. The symptoms caused by adhesions may be simply obscure abdominal pains of a dragging nature, or actual obstructive symptoms may be produced. The question as to reopening the abdomen, apart from acute cases, is often a difficult one.

The Constitutional Changes caused by Removal of both Ovaries.[1] — These changes are peculiar to this operation, although similar changes occur as the results of the normal menopause, and also, at a later stage, as the result of removal of the uterus. There has been much discussion on the symptoms which follow the removal of both ovaries. Many operators believe that they are frequently very acute, and that the subjects of this operation are exposed to great discomfort. They believe that the menopause when artificially induced is followed by more acute symptoms than when it comes about in the course of nature. For this reason they urge that one ovary or a portion of one ovary should be left whenever this can be done without subsequent danger to the patient. My own experience does not confirm this view, and I believe the effects of bilateral oöphorectomy have from this point of view been much exaggerated. The question does not assume a practical aspect in dealing with bilateral cysts or tumours of the ovary. Here we have merely to consider the risk to the patient of leaving a diseased structure. No one would remove an ovary without sufficient cause in a woman who was still capable of bearing children, and even the risk of a second operation may be taken if there is a possibility of the patient having a child between the first and second operation. For this reason also resection of an innocent cyst from healthy ovarian tissue may be employed. But when it becomes a question of retaining one ovary or a portion of one ovary when the other ovary and both tubes have been removed, purely on the ground that it is of importance to preserve the internal secretion of that ovary, I believe this advice is founded on theory, and not on practical experience. There are cases undoubtedly in which patients seem to suffer severely from all sorts of nervous symptoms after the removal of both ovaries, but I have seen cases in which the nervous symptoms have been equally troublesome when one ovary has been left. In my view it depends more upon the patient than upon the operation. A highly-strung woman will have acute nervous symptoms following the natural menopause, or after an operation in which one ovary is taken and another left.

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[1] The general bearings of this subject are discussed in the Article on Disorders of Function (Vol. I. p. 287).—Editors.

I have investigated the later histories in a fairly large number of operations for removal of the uterus for fibroid tumour, in which it is my custom to remove both ovaries, and I have found that the serious discomforts which are supposed by some to follow the radical operation did not occur, except in very rare cases. The exceptional cases where the sufferings might be described as acute were only found in highly nervous women. In some of the cases in which the complaints were most bitter, it was found that, for some reason or other, one ovary had been left.

As to the results on the sexual feelings, this is a question on which it is exceedingly difficult to obtain reliable evidence. It is not a subject upon which patients are very communicative. Some statistics have been published by Giles.[1] The number of operations in which both ovaries were removed was 277, the percentage of cases traced 76·6, and the conclusion arrived at was that in a large percentage of cases the sex-instincts are not affected : in 68 per cent they were either unaffected or increased ; in 16 per cent they were diminished, and in a further 16 per cent they were lost.

[1] *Journal of Obst. and Gyn. of the Brit. Empire*, April 1910.

HYSTERECTOMY

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Synopsis

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I. Historical Summary

The two principal conditions for which Hysterectomy has been practised are fibroids and carcinoma. The operative methods and objects in the two conditions differ in important respects; and it will therefore be convenient to review separately the historical evolution of the two operations.

Hysterectomy for Fibroids.—The idea of removing a uterus affected by tumour-growth was undoubtedly inspired by the demonstration of the possibility of removing ovarian tumours, although the lapse of a generation separated the first successful ovariotomy by Ephraim Macdowell of Kentucky in 1809, from the first hysterectomy in 1843. In that year *Heath* (1) [1] performed and reported an abdominal hysterectomy for fibroids. The influence of ovariotomy on most of the early operators is shown by their attempt to treat the uterine pedicle like the ovarian, and ligature it *en masse*, and we shall see that it was not until this influence had been shaken off that hysterectomy was established as a successful operation. Heath passed two double ligatures by means of a sharp-pointed aneurysm-needle through the cervix uteri, immediately below the circumference of the tumour. Each ligature was then firmly tied, so as to include one-half of the neck of the womb and broad ligaments. The parts were then excised and removed. No bleeding ensued from the cut surface; indeed, throughout the operation, no more than three ounces of blood were lost. The patient died of haemorrhage seventeen hours after the operation.

1844. In the following year *Charles Clay* (2) of Manchester removed the uterus weighing 20 pounds and two ovarian tumours weighing 12 pounds. The exact method is not stated, but he says: "I determined to extirpate the whole, converting the vagina into a cul-de-sac." So presumably a ligature was passed round the broad ligaments and upper part of the vagina, just below the cervix. There was a good prospect of recovery; but "on the thirteenth day the nurse put an end to all the flattering prospect by an accident. On lifting her from her bed to ease the bedding, the patient fell on the floor somewhat violently, although three women had hold of her; the result was, inflammatory action arose, and though every assistance was rendered, she died on the morning of the fifteenth day." Clay claimed that this was "the first operation in the world where both uterus and ovaries were extirpated through the abdominal walls."

1846. The next was by *John Bellinger* (3), who was apparently the first to attempt the separate ligature of the arteries. After raising the tumour he divided the lateral ligaments. "They were very vascular, and many arteries (the number not distinctly remembered) required tying. Animal ligatures were applied to all of them. The neck of the uterus was cut across about three-quarters of an inch above the os tincae, and the tumour removed." The patient died of peritonitis on the fifth day.

1853. To *Burnham* (4) is due the credit of the first *successful* hysterectomy. He ligatured each of the pedicles of the fibroid tumour and the ovarian cysts; these tumours being excised, the uterus was separated to just below the point where the cervix joins the vagina. The uterine arteries were tied. In this year, *Kimball* (5) also had a successful case. He adopted the same plan as Heath, that is, the uterus was transfixed from before backwards, at the level of the internal os, and each half of the uterus was tied separately.

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[1] The numbers refer to the Bibliographical Summary on p. 454.

1863. In January of this year, *Clay* (6) performed a successful hysterectomy. He ligatured the broad ligaments separately, and then placed a ligature, consisting of three strands of strong Indian hemp, on the cervix immediately above the plane of the os, and divided the cervix. "The tumour was removed with very trifling loss of blood; the integuments were brought together by six interrupted sutures, padded, bandaged, and the patient placed comfortably in bed in about fifteen minutes from the commencement. Three grains of solid opium were given."

It is permissible to comment, first, on the rapidity of the operation, which compares very favourably with the time taken for a hysterectomy at the present day: it is true that the method was crude, and no doubt to our minds suggestive of the procedure of the post-mortem room more than that of the operating theatre; and, secondly, on the boldness of a surgeon who could trust to six interrupted sutures to close a wound eleven inches long, which Clay tells us was the length of the incision in this case.

In this same year, in the month of April, *Koeberlé* (7) of Strasbourg performed his first operation by the method with which his name will always be honourably linked, that of the serre-nœud. He passed a kind of large needle carrying a double thread of twisted iron, bent into two equal lengths, through the cervix, from before backwards, below the level of the internal os. The loops of the threads were divided, and each double thread was then carried round the cervix on one side and the other, embracing the broad ligament as near to the ovary and tube as possible, and tightened by means of a serre-nœud specially devised for the purpose. When the constriction was judged to be sufficient the ovaries and tubes were divided and the cervix was amputated. The serre-nœud with the threads was left in position within the pelvis, the operation being thus 'intraperitoneal,' but the ends of the threads with the serre-nœud projected from the lower angle of the wound, and came away, together with the necrotic portion of the stump, about the tenth day.

Koeberlé's method was a striking advance on the method of ligature *en masse*, because the outstanding risk of the latter plan was the shrinkage of the tissues afterwards with consequent risk of haemorrhage. Yet its very success was a drawback from the point of view of eventual progress, for otherwise the method of separate ligation of the uterine arteries might have come into use earlier than it did.

1869. *Péan* (8) took up Koeberlé's plan with enthusiasm, and introduced an important modification by bringing up the cervical stump and fixing it in the lower angle of the wound, thus making the treatment of the stump extraperitoneal. Like Koeberlé his ligatures traversed the cervix as well as encircling it.

1872. It is not to be supposed that the operation of hysterectomy escaped adverse criticism, and even direct opposition. It is interesting to note that in this year it was formally condemned by the Academy of Medicine of Paris (9), after a report made by Dumarquay upon the work of Koeberlé and Péan. Richet alone expressed a reserved opinion. It must, of course, be remembered that the mortality of the operation, even in the experienced hands of the two operators referred to, was very high.

1876. A further modification was first adopted in 1876 by *Kleberg* (10) and published in the following year; this consisted of an elastic ligature temporarily applied round the cervix. This plan was strongly supported by Martin, whilst Hegar in 1880 employed it for the permanent ligature of the pedicle.

1878. After fifteen years of the almost exclusive use of the serre-nœud in various forms, we find another serious attempt to revert to the much sounder principle of the separate ligature of the uterine arteries. This was made by *Mikulicz* (11), who operated on a case on April 2, 1878, and after placing a triple ligature on the broad ligaments, sought the uterine arteries and tied them separately. In the same year *Schröder* (12) described his method, which was on similar lines, at the Cassel Congress; and again the following year at the Baden-Baden Congress. He recommended the ligature of the four principal arteries (uterine and ovarian) and also those of the round ligaments. In this year also *Spencer Wells* (13) began independently the method of which he gave a description in 1880 at the Cambridge Meeting of the British Medical Association. The method was based on the analogy of the treatment of ovarian pedicles, and consisted of ligature *en masse* or in several parts, and apposition of the peritoneum over the surface of the stump. Thus all three operators revived independently the intraperitoneal method with ligature of the vessels; whilst the covering over of the stump by peritoneum was due specially to Spencer Wells and Schröder.

1879. A point of interest in connection with this year was the proposal by *Tillaux* (14) of the use of the word " hysterectomy " instead of the word " hysterotomy " which had been in vogue up to that time. " Hysterotomy " had the disadvantage that, as it merely meant a cutting of the uterus, it was used indiscriminately to imply both hysterectomy and myomectomy. The latter word was derived from Germany.

1887. *Eastman* (15) appears to have been the first to recommend the definite fashioning of anterior and posterior peritoneal flaps for the purpose of covering over the face of the stump.

From the foregoing sketch it will be realized that by the year 1887 all the important procedures embodied in the modern operation of hysterectomy had been practised and described ; nevertheless the extraperitoneal method continued to be carried out by many operators, chiefly because it showed a lower mortality.

The ultimate triumph of the intraperitoneal method with separate ligation of the uterine arteries was due to the persevering work of various operators who deserve to be remembered on this account ; although in the light of the foregoing sketch we must disallow the claims of priority which have been advanced on behalf of some of them.

1888. Schröder's pupil, *Hofmeier* (16), at the Congress at Hallé in this year, laid down clearly the principles of Schröder's operation. " As to haemostasis, this can be obtained by the separate ligature of the arteries, and by suturing the edges of the stump as is done in amputation of the cervix. Over the stump thus sutured, the peritoneum is brought together with catgut, so that the stump is extraperitoneal" (or, as it would now be expressed, retroperitoneal).

1889. *Stimson* (17) also recommended the separate ligature of the arteries, and the covering over of the stump with peritoneum.

1890. *Milton* (18) described an operation in a manner that would apply exactly to a hysterectomy at the present day, as will be seen from the following summary of the steps of the operation : ligature of the broad ligaments, transverse division of the peritoneum 1½ cm. above the bladder reflection, stripping down of the peritoneum, shaping of a posterior flap, seizing of the uterine vessels with forceps, amputation of the uterus at the level of the internal os, excision of a portion of the mucosa of the cervix, suture of the two cervical flaps, ligature of the uterine arteries, suture of the peritoneal edges over the stump, closure of the wound without drainage. The patient recovered.

In the same year *Riddle Goffe* (19) described a similar method. He had arrived at it independently, but was incorrect in describing it as " new."

1891. *Chrobak* (20) gave a minute and careful description of the steps of the operation, which had a great vogue in German-speaking countries, so that subtotal hysterectomy came to be known as 'Chrobak's operation.' It was not essentially different, however, from Schröder's method.

1892. *Baer* (21) did for the English-speaking peoples what Chrobak had done for the Teutonic ; his operation differed from the preceding only in the omission of sutures from the cervical tissues, a point which at the present day is not regarded as being of importance. It has often been assumed by English and American writers that Baer originated the plan of the separate ligature of the uterine arteries ; if the merit of being the first to carry out this plan be assigned to any one, it must be to Bellinger. Nevertheless the wide publicity given to Baer's communication had an excellent result in making the method more widely known, and it is safe to say that the general adoption of intraperitoneal hysterectomy with separate ligature of the uterine arteries dates from the year 1892. Since that time no substantial modification has been made in the operation as carried out for ordinary cases, but we may conclude this section of our historical sketch by referring to some special modifications.

Total Hysterectomy or Panhysterectomy.—This means the removal of the whole cervix, together with the rest of the uterus, instead of the amputation of the uterus at or about the level of the internal os, leaving the vaginal cervix undisturbed. Charles Clay's first hysterectomy was really a total hysterectomy, but the method was essentially crude.

The first definite and carefully devised total hysterectomy seems to have been done in 1881 by *Bardenheuer* (22). In 1892 *Doyen* (23) reported his method of panhysterectomy, which will be described later. The essential feature of it was the opening of the vagina from behind the cervix and subsequent dissection carried up in front of the cervix.

In 1894 *Pryor* (24) published an account of a method of which the essential feature was the successive division of the broad ligament and uterine artery of one side, the opening of the vagina from that side, and the carrying up of the dissection in the reverse direction on the other side.

Some special Cases.—In 1896 *Howard Kelly* (25) described a method specially applicable to intraligamentary fibroids ; it is a subtotal hysterectomy, carried out on much the same principle as Pryor's operation, that is, a continuous dissection from one side to the other. For cervix-fibroids, for some cases complicated by pus-tubes, and for certain cases in which fibroids have dense intestinal adhesions, *Kelly* (26) modifies the usual operation in one of three ways :

(1) By a median sagittal section of the uterus with the tumours.
(2) By a bisection of the tumour alone.
(3) By a coronal bisection of the uterus in its cervical part.

Vaginal Hysterectomy for Fibroids.—This procedure may conveniently be referred to here. At a time when vaginal operations had great vogue, and especially when vaginal hysterectomy for carcinoma and for suppurative conditions in the pelvis had met with a considerable degree of success, *Péan* (27) conceived the idea of removing the uterus when considerably enlarged by fibroids, by means of the process of 'morcellement,' that is, the cutting up of the uterus and tumours into fragments. This was in 1886. During succeeding years the method was elaborated. The high mortality of abdominal hysterectomy is the only explanation that one can advance for the fact that this crude, barbarous, and bloody operation was taken up with considerable enthusiasm by certain eminent surgeons, among whom we may mention *Richelot* (28), *Segond* (29), and *Doyen* (30) in France; *Jacobs* (31) in Belgium; and the brothers *Landau* (32) in Germany. In England and America also, hysterectomy by morcellement had its exponents and supporters.

At the present time the operation may be said to be extinct, and to have no more than a historic interest.

Hysterectomy for Cancer.—Early hysterectomies for carcinoma were done by the vaginal route. Various cases were recorded up to the end of the eighteenth century, the earliest being in 1507, when Berengarius of Bologna is said to have done a partial vaginal hysterectomy. These early operations appear to have been limited to cases in which the uterus was prolapsed, and a more or less crude amputation of the organ above the disease was carried out. In fact Baudelocque, who performed twenty-three partial or total hysterectomies from 1801 to 1816, taught that the first step in the operation was artificially to prolapse the uterus; amputation was then effected above the disease, and in favourable cases the prolapsed organ and appendages were cut away. As no systematic procedure was done, I shall not go into details of these early cases, but refer those who are interested to the historical summary given by *Henrotin* (33).

There seems to be no doubt that the first *vaginal* hysterectomy for carcinoma deliberately planned and carried out was that of *Langenbeck* (34), who operated in 1813. He tied the vessels with ligatures and removed the whole of the uterus, which was prolapsed. The patient survived the operation thirty years. The first hysterectomy of a non-prolapsed carcinomatous uterus was done by *Sauter* of Constance (35), in 1822, with a successful result, and in 1829 *Récamier* (36) had a successful case. He divided the bases of the broad ligaments and ligatured the uterine arteries. In the same year *Roux* (37) reported two other successful cases operated on by the same method.

The first *combined abdominal and vaginal hysterectomy* was done by *Delpech* (38) as far back as 1830. Although some successful cases were afterwards reported from time to time, the results as a whole were so bad that the operation was practically abandoned, until it was re-introduced with a greater hope of success in the antiseptic era.

It was not until 1878 that an effort to deal with carcinoma of the uterus by *abdominal* hysterectomy was seriously made, and in that year ***Freund*** (39) described his method. Such eminent surgeons as Schröder, Billroth, and Czerny adopted it, but the results were appalling, and ***Rokitansky*** (40), four years later, collected 95 cases by these and other operators showing 65 deaths; and every one of the remaining 30 cases succumbed to recurrence. Meanwhile *Czerny* (41), in 1879, had revived the vaginal method of Sauter and Récamier, and this soon supplanted the abdominal operation.

The mortality of vaginal hysterectomy in the following years showed a striking diminution, but the after-results continued to be most unsatisfactory; and the consequence was that when the technique of abdominal hysterectomy for fibroids was placed upon a surer footing by the abolition of the serre-nœud and the systematic ligation of the uterine vessels, the thoughts of surgeons turned once more to the abdominal route for uterine carcinoma. Freund's method was revived and modified by ***Ries*** (42), ***Clark*** (43), ***Werder*** (44), and ***Wertheim*** (45).

Ries showed, by experiments on dogs and on the cadaver, that it was possible to do a radical operation, including the removal of the uterus and appendages, the cellular tissue of the broad ligaments, and the lymphatic glands as far as the bifurcation of the common iliac artery. To Clark was due the credit of putting this into practice in the case of a patient at the Johns Hopkins Hospital. The special modification introduced by Wertheim was the clamping of the vagina below the growth in order to lessen the risk of infection of the tissues with cancer cells; and this, together with his patient advocacy of the radical operation and his extensive practice of it, has led to the operation being generally called by his name. Wertheim's operation, which will be described fully later on, may be considered as the operation of choice in cases in which the disease is early enough to admit of radical treatment.

I append a short Bibliography, which has no pretensions to being exhaustive, but embraces the important contributions which have gone to the making of the history of hysterectomy.

Abdominal Hysterectomy for Fibroids

1. 1843. Heath (A. M.). "Case of Excision of the Uterus by Abdominal Section," The London Medical Gazette, 1843, p. 309.
2. 1844. Clay (Charles). Medical Times, 1844; and Trans. Obstet. Soc. Lond. vol. v. for 1863, p. 66.
3. 1846. Bellinger (John). "Operations for the Removal of Abdominal Tumours," Southern Journal of Med. and Pharmacy, May 1847, vol. xi. No. 3, p. 241.
4. 1853. Burnham (Walter). "Extirpation of the Uterus and Ovaries for Sarcomatous Disease," Nelson's North American Lancet, vol. viii. January 1854, Art. 36, p. 147.
5. 1853. Kimball (G.). "Successful Case of Extirpation of the Uterus," Boston Medical and Surgical Journal, 1855, vol. lii. p. 240.
6. 1863. Clay (Charles). "Observations on Ovariotomy, etc.," Trans. Obstet. Soc. Lond. vol. v. for 1863, p. 69.

7. 1863. KOEBERLÉ (E.). "Documents pour servir à l'histoire de l'extirpation des tumeurs fibreuses de la matrice par la méthode sus-pubienne," Gazette Médicale de Strasbourg, 1863, No. 10, p. 153.
8. 1869. PÉAN (J.). Reported in Péan and Urdy, "Hystérotomie." Paris, 1873.
9. 1872. Formal condemnation of Hysterectomy by the Academy of Medicine of Paris. Bull. de l'Acad. de Méd., 1872, pp. 1062-1075.
10. 1876. KLEBERG (B. G.). Method first published in the Petrograd med. Woch., September 24 and October 6, 1877, p. 333.
11. 1878. MIKULICZ. Method published later, "Über die Totalextirpation des Uterus," Wien. med. Woch., 1880, Nos. 47, 48, 52.
12. 1878. SCHRÖDER. Arch. f. Gyn., 1880, vol. xv. p. 271; and Arch. f. Gyn., 1881, vol. xvii. p. 478.
13. 1878. SPENCER WELLS. Method published in Brit. Med. Journ., 1880, vol. ii. p. 373.
14. 1879. TILLAUX. Bull. de l'Acad. de Méd. de Paris, 1879.
15. 1887. EASTMAN. "A Case of Hysterectomy, with Practical Comments on Laparotomy," Trans. Indiana State Med. Soc., 1887, pp. 198 and 227.
16. 1888. HOFMEIER. "Über Myotomie," 2^me Congrès de Gyn. et d'Obst., Halle, May 1888, reported in Verhandl. der Deutschen Gesell. f. Gyn., 1888, p. 144.
17. 1889. STIMSON. "Ligation of the Uterine Arteries in their Continuity as an Early Step in Total or Partial Abdominal Hysterectomy," New York Med. Journ., 1889, vol. xlix. p. 277.
18. 1890. MILTON. "Supra-Vaginal (abdominal) Hysterectomy with the Scissors," The Lancet, 1890, vol. ii. p. 1155.
19. 1890. GOFFE (J. RIDDLE). "A New Method (the intra-abdominal but extraperitoneal method) of disposing of the Pedicle in Supra-vaginal Hysterectomy for Fibroid Tumour, with Report of four successful Cases," Amer. Journ. of Obst., 1890, vol. xxiii. p. 372.
20. 1891. CHROBAK. "Zur Extirpatio Uteri Myomatosi Abdominalis (die retroperitoneale Stielversorgung)," Cent. f. Gyn., 1891, No. 35, p. 713.
21. 1892. BAER (B. F.). "Supra-vaginal Hysterectomy without Ligature of the Cervix in Operations for Uterine Fibroids, a New Method," Trans. Amer. Gyn. Soc., 1893, vol. xviii. p. 62.

SPECIAL METHODS OF ABDOMINAL HYSTERECTOMY FOR FIBROIDS

22. 1881. BARDENHEUER. Die Drainierung der Peritoneal-höhle, mit Anhang—die total Exstirpation des Uterus wegen Fibroid. Stuttgart, 1881, p. 271.
23. 1892. DOYEN (E.). "Hystérectomies abdominales," Arch. prov. de chir., December 1892, t. i. No. 6, p. 494.
24. 1894. PRYOR (WM. R.). "A New and Rapid Method of Dealing with Intraligamentous Fibromata," Med. News, 1894, vol. lxv. p. 602.
25. 1896. KELLY (HOWARD A.). "Hysteromyomectomy and Hysterosalpingo-oöphorectomy by continuous Incision from left to right or from right to left," Johns Hopkins Hosp. Bull., 1896, vol. vii. Nos. 59 and 60, p. 27.
26. 1900. KELLY (HOWARD A.). "The Evolution of my Technique in the Treatment of Fibroid Tumours," Amer. Journ. of Obst., 1900, vol. xlii. p. 289.

VAGINAL HYSTERECTOMY FOR FIBROIDS

27. 1886. PÉAN (J.). "De l'hystérectomie vaginale totale appliquée au traitement des tumeurs fibreuses multiples de l'utérus; morcellement des tumeurs; pincement définitif des ligaments larges; absence de fermeture du vagin," Gaz. des hôp., 1886, vol. lix. p. 950. Also other papers, the references to which will be found in Kelly and Noble's Gynaecology and Abdominal Surgery, vol. i. p. 762.
28. 1893. RICHELOT (M. G.). "Sur le traitement des fibromes utérins par l'hystérectomie vaginale," L'Union médicale, 1893, vol. lv. No. 8, p. 85.
29. 1895. SEGOND (PAUL). "Des plus gros fibromes justiciables de l'hystérectomie vaginale," Ann. de gyn., 1895, vol. xliv. p. 328.
30. 1897. DOYEN (E.). Technique chirurgicale. Paris, 1897.
31. 1894. JACOBS (CHARLES). "Die späten Resultate der vaginalen Hysterektomie bei Affectionen der Anhänge im Vergleich zu denen der abdominalen beiderseitigen Ovario-Salpingectomie," Cent. f. Gyn., 1894, No. 18.
32. 1896. LANDAU (L. AND T.). Die vaginale Radikaloperation. Berlin.

HYSTERECTOMY FOR CARCINOMA

33. 1907. Henrotin (Fernand). Historical summary in Kelly and Noble's Gynaecology and Abdominal Surgery, vol. i. p. 759.
34. 1813. Langenbeck (M. A.). Recorded in his De totius uteri extirpatione. Göttingen, ex off. Dieterichiana, 1842.
35. 1822. Sauter (J. N.). Die gänzliche Exstirpation der carcinomatösen Gebärmutter. Constance, W. Wallis, 1822.
36. 1829. Récamier (J. C. N.). Recherches sur le traitement du cancer, etc. Paris, Gabon, 1829.
37. 1829. Roux. "Observations d'extirpation de la matrice, d'après la méthode de M. le Prof. Récamier," Arch. gén. de méd., 1829, vol. xxi. p. 238.
38. 1830. Delpech (J.). Arch. gén. de méd., 1830, vol. xxiv. p. 299.
39. 1878. Freund (W. A.). "Zu meiner Methode der totalen Uterus-Exstirpation," Centr. f. Gyn., 1878, No. 12, p. 265.
40. 1882. Rokitansky (Karl). "Zur total Exstirpation des carcinomatösen Uterus," Wiener med. Presse, 1882, vol. xxiii. No. 21, p. 656.
41. 1879. Czerny (V.). "Über die Ausrottung des Gebärmutter Krebses," Wiener med. Woch., 1879, pp. 1171, 1198, 1227, and 1279.
42. 1895. Ries (E.). "Eine neue Operationsmethode des Uteruscarcinoms," Zeits. f. Geb. u. Gyn., 1895. vol. xxxii. p. 266.
43. 1895. Clark (J. G.). "A more Radical Method of Performing Hysterectomy for Cancer of the Uterus," Johns Hopkins Hosp. Bull., 1895, Nos. 52, 53, p. 120.
44. 1898. Werder (X. O.). "A New Operation for the Radical Treatment of Cancer of the Cervix," Amer. Journ. of Obst., 1898, vol. xxxii. p. 289.
45. 1902. Wertheim (Ernst). "Ein neuer Beitrag zur Frage der Radikaloperation beim Uterus-Krebs," Arch. f. Gyn., 1902, vol. lxv. p. 1.

II. INDICATIONS FOR HYSTERECTOMY

The indications for hysterectomy fall into five categories :

A. Diseases of the uterus.
B. Displacement of the uterus.
C. Functional disorder.
D. Diseases of the ovaries and tubes.
E. Malformations.

A. Diseases of the Uterus.—1. *Malignant Disease.* This is of several kinds.

(*a*) *Carcinoma and Adenocarcinoma of the Body of the Uterus.*—Of all positions in the pelvis, the body of the uterus is the most favourable for radical surgical treatment. This is because the lymphatic glands are affected comparatively late, and because the disease does not readily spread to surrounding organs. Consequently the growth can be completely extirpated with relative ease, and the risks of recurrence are slight.

(*b*) *Carcinoma of the Cervix.*—The limitations of hysterectomy differ in the two types. In squamous-celled carcinoma, or epithelioma of the vaginal portion, the question of operability depends on the degree to which the growth has spread down the vaginal walls : in adenocarcinoma of the cervical canal it depends on the extent to which the growth has penetrated the wall of the cervix and spread to the bladder and ureters.

(*c*) *Chorionepithelioma of the Uterus.*—In this case the operative limitations depend, not so much upon the local progress of the disease, as upon the occurrence of metastatic deposits in other and sometimes distant organs.

(*d*) *Sarcoma of the Uterus.*—As a rule, the diagnosis of this condition is not made until after the operation, most cases being regarded beforehand as carcinoma or fibroids of the uterus.

2. *Fibroids* (*fibromyoma*) *and Adenomyoma of the Uterus.*—The latter condition, like sarcoma, is seldom diagnosed beforehand, the clinical symptoms and physical signs being indistinguishable from those due to fibroids. Fibroids form, at the present time, the most widespread indication for hysterectomy. A proper appreciation of the seriousness of these tumours, the frequency of grave complications, and the phenomenal diminution of the operative mortality have combined to save unfortunate women who have these tumours from the disappointments of electro-therapeutics and the futility of the helpless policy of waiting for the menopause.

3. *Fibrosis of the Uterus.*—Hysterectomy is now recognized as the proper treatment of this condition, the diagnosis of which is frequently arrived at only by exclusion and by the failure of repeated curetting to stop haemorrhage.

4. *Hydatids of the Uterus.*—This rare condition is not likely to be diagnosed beforehand. In the only case that I have seen (which is also, I believe, the only case reported in this country[1]) the condition was thought to be one of fibroids. A diagnosis of hydatids would certainly be an indication for hysterectomy.

5. *Tuberculosis of the Uterus.*—This is another rare condition, not usually recognized before operation ; if the correct diagnosis were made, the question of hysterectomy would depend on the evidences of tuberculosis elsewhere in the system.

6. *Sepsis of the Uterus.*—In some cases of uterine sepsis following child-birth, hysterectomy has been practised with good results ; but much must depend, in a given instance, on whether the condition has passed on to one of general septicaemia, in which case hysterectomy would be useless. The uterus may also be septic in association with acute tubal sepsis.

B. Displacement of the Uterus.— Hysterectomy has been advocated and practised in some cases of procidentia. In the great majority of cases it is not good practice because of the invariable tendency afterwards to prolapse of the vaginal walls. It is much better, as a rule, to retain the uterus and use it, by some form of uterine fixation, for holding up the vaginal walls. In the only case in which I did a hysterectomy for intractable procidentia, after the failure of hysteropexy by reason of subsequent hyperplasia of the supravaginal cervix, the vaginal walls became completely everted, and I had to remove the whole vagina and obliterate the passage.

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[1] Arthur E. Giles, " A Case of Hydatids of the Uterus," *Lancet*, 24th June 1911, p. 1700.

C. Functional Disorder.—It happens, in exceptional cases of dysmenorrhoea, that ordinary drugs fail completely to relieve the pain; dilatation and curetting have no effect; and the patient may be quite invalided for several days every month, obtaining no relief except from large doses of morphia. When such a patient has to earn her living, and is disabled therefrom by the recurring pain, hysterectomy is a justifiable procedure.

D. Diseases of the Ovaries and Tubes.—When a patient has double ovarian tumours, particularly carcinoma, or double pus-tubes, and the uterus is involved in adhesions, so that only a badly-damaged and useless organ would remain after a double ovariotomy or salpingo-oöphorectomy, there is a clear indication for the removal of the uterus as well as the adnexa. Some operators go further, and advise hysterectomy in nearly all cases of double ovariotomy or salpingo-oöphorectomy. In my opinion it is better to leave the uterus when it is healthy or not appreciably damaged, as the duration and severity of the operation are thereby lessened, and the likelihood of subsequent trouble arising in such a uterus is very small.[1]

E. Certain Malformations.—In cases of atresia of the vagina, when the patency of the canal cannot be restored or maintained, and the patient suffers from great menstrual pain or has a haematometra, hysterectomy is the best treatment. In some other exceptional cases of gross malformation hysterectomy may be indicated; as in the case of hernia of the uterus in a pseudo-hermaphrodite male; and in some conditions of double uterus with lateral haematocolpos. No general rules, however, can be laid down in such cases, and each will have to be dealt with according to the particular circumstances present.

III. Operative Methods

The general subject of operative technique, including the mode of preparation of the patient and the surgeon and the sterilization of instruments and accessories, is dealt with elsewhere; and therefore it is not necessary to discuss it here. After a list of the instruments required has been given, the description of each operation will begin at the point where the patient is under anaesthesia.

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[1] This point is more fully discussed in the Article on Inflammatory Affections of the Fallopian Tubes (Vol. I. p. 623).—Editors.

A. Vaginal Hysterectomy

Cases suitable for Vaginal Hysterectomy.—The most suitable cases are those in which the uterus is but little (if at all) enlarged, the cervix healthy, and the vagina capacious. These conditions necessarily restrict the indications, but we may cite cases of fibrosis, and the very rare cases in which hysterectomy is required for dysmenorrhoea. Formerly this operation was the one of election for carcinoma of the cervix ; and as has been stated, it has been practised for fibroids ; but in both these conditions the majority of experienced surgeons now prefer the abdominal route ; and even for cases of fibrosis and dysmenorrhoea, the abdominal route is better.

Instruments required :

Auvard's speculum. Vaginal retractors.
Bladder sound. Catheter.
Uterine sound. Curette or sharp spoon.
2 Volsella.
Scalpels. Scissors.
Dissecting forceps.
Artery forceps, including some long-handled ones.
Curved pedicle needles.
Curved needles and needle-holder.
Suture material (silk, linen thread, or catgut).
Swab-holders.
Ovum forceps.

Steps of the Operation.—The patient is placed in the lithotomy position, and the speculum is introduced.

Preliminary Stage.—In certain cases of carcinoma of the cervix it may be necessary to scrape away all the friable portion of the growth, in order that a secure hold of the cervix may be obtained. After such scraping the cervix should be swabbed over with methylated spirit and then with iodine (2 per cent in spirit). When it is possible, the cervix should be sewn over in such a way as to shut off the cancerous tissues from the field of operation ; and the ends of the sutures, if left long, will serve as a tractor.

Stage 1. The cervix is firmly held by means of a volsellum or the suture-tractors just mentioned, and with a scalpel the mucous membrane on its anterior aspect is incised transversely, low enough down to avoid injuring the bladder (Fig. 152). This point is determined by introducing a bladder sound, the end of which will show how low the bladder comes down. The bladder is then pushed up from the anterior surface of the cervix by means of the forefinger protected with gauze (Fig. 153). The lower ends of the ureters are carried up with the base of the bladder, out of harm's way. If the operator has struck the right plane, the separation is accomplished easily. On reaching the level of the internal os, the bladder and uterus are connected only by the utero-vesical fold of peritoneum, the thinness of which makes it easy to recognize. This fold is picked up and divided transversely with the scissors, exposing the anterior surface of the uterine body within the peritoneal cavity (Fig. 154). The opening is enlarged carefully with the fingers (Fig. 155).

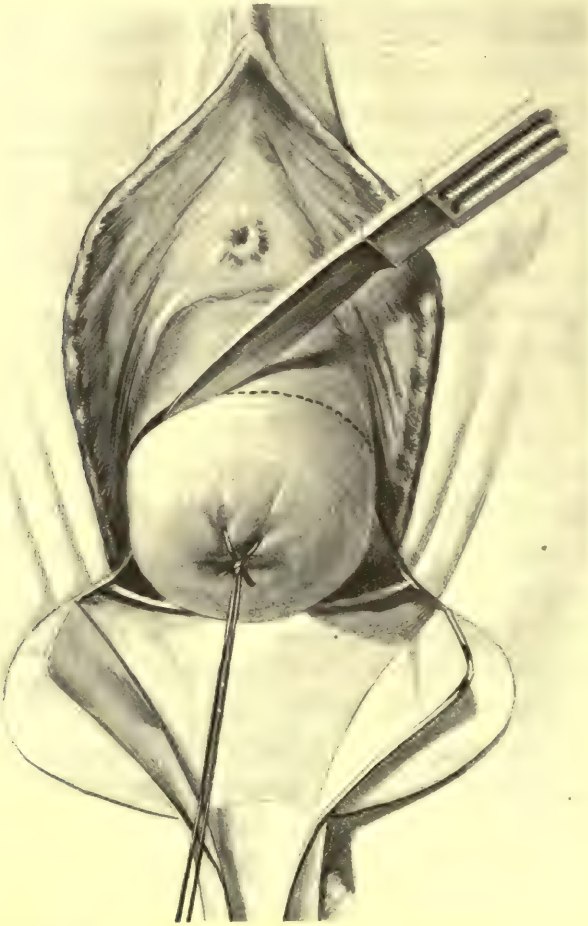

Fig. 152.—Vaginal hysterectomy. (First stage.)
Division of mucous membrane on anterior aspect of cervix.

Stage 2. The cervix is held forwards, the vagina in the posterior fornix is picked up with forceps just where it is passing on to the cervix, and divided transversely with scissors, opening up the recto-vaginal pouch (Fig. 156). The blades of the scissors must be kept close to and parallel with the cervix, to avoid injuring the rectum. The mucous membrane at the sides of the cervix is incised with the scalpel, connecting together the anterior and posterior incisions, and the cervix can then be drawn down somewhat out of its vaginal sheath.

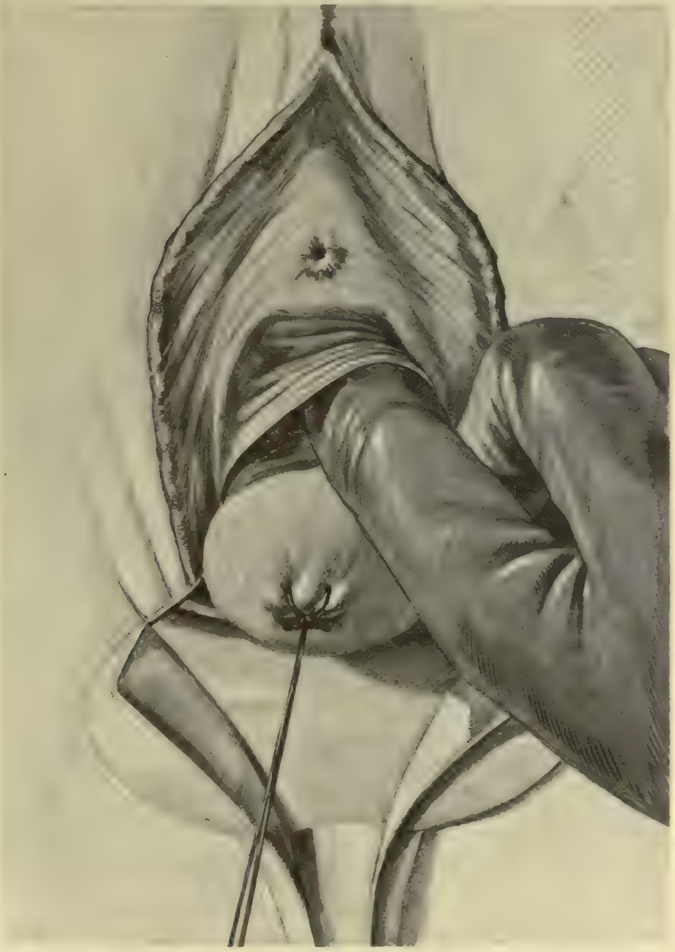

Fig. 153.—Vaginal hysterectomy. (First stage.)
Separation of the bladder from the cervix.

Stage 3. The uterus is now held in place only by the broad ligaments, which are dealt with next. The bladder and ureters being held forwards out of the way by means of an anterior vaginal retractor, a pedicle needle armed with silk is passed through the base of the broad ligament, guided by the left thumb and forefinger (Fig. 157). The needle passes above the uterine artery. The end of the silk loop is seized with forceps, the needle is withdrawn, and the ligature securely tied, as far away from the cervix as possible. The tissues between the ligature and the side of the uterus are divided with scissors, care being taken to keep far enough from the ligature to prevent this from slipping (Fig. 158); and the artery on the opposite side is then secured in a similar way. When the bases of the broad ligaments have been divided, the mobility of the uterus is greatly increased and it can usually be drawn low down into the vagina.

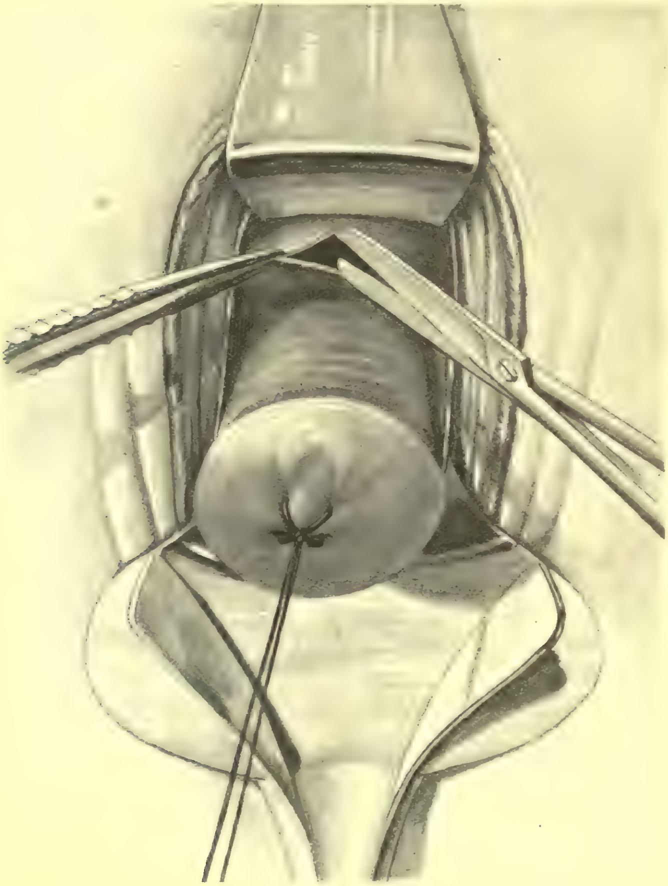

Fig. 154.—Vaginal hysterectomy. (First stage.)
Opening of the utero-vesical pouch.

Stage 4. The next step is to bring the fundus of the uterus down into the vagina through the opening in the utero-vesical pouch. This is best accomplished by passing a volsellum through this opening and seizing the anterior wall of the fundus; traction on the volsellum, aided if necessary by the finger of the left hand passed through the posterior opening and pushing the fundus forwards, will usually suffice to deliver the fundus into the vagina. The uterus is now held on each side by the upper part of the broad ligament. This can be transfixed by means of a pedicle needle carrying a double silk thread (Fig. 159), the end of the thread is seized, the needle withdrawn, and one thread is tied tightly round the upper part of the broad ligament, including the tube when the ovary is to be left behind, whilst the other thread is tied round the remaining lower part of the broad ligament (Fig. 160). If the ovary and tube are to be removed they are drawn towards the uterus, and the upper ligature is tied beyond them. The broad ligament is then completely divided with scissors between the ligatures and the uterus, and the organ hangs down in the vagina, held only by the broad ligament of the other side. This is secured and

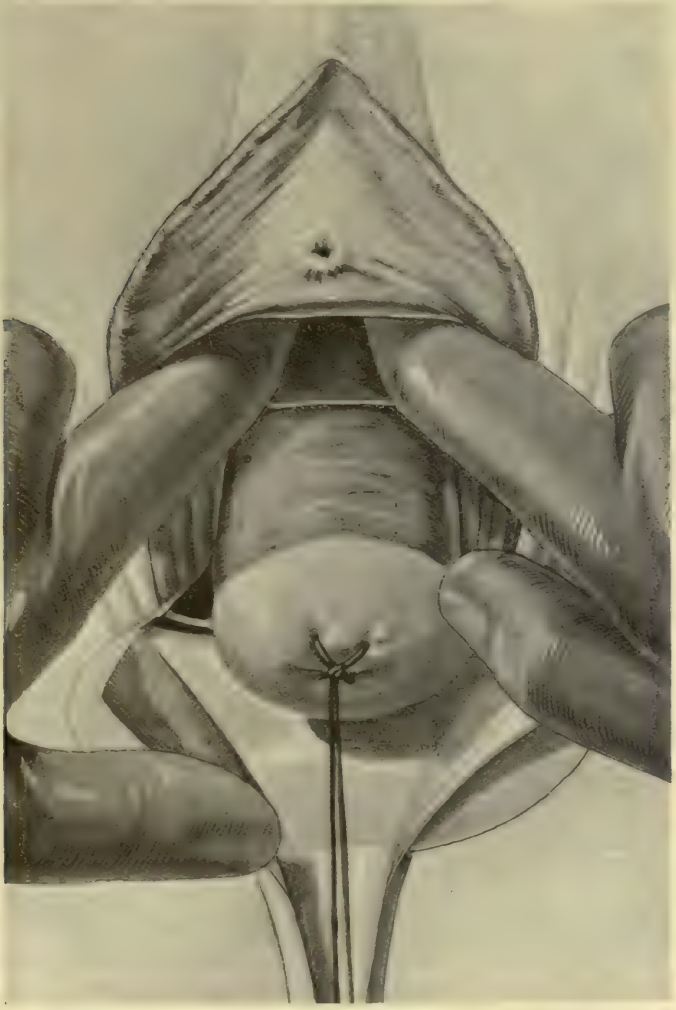

Fig. 155.—Vaginal hysterectomy. (First stage.) Enlarging the opening in the utero-vesical pouch.

divided in the same way and the uterus is removed. The threads on the broad ligaments are left long and the ends of those on each side are knotted together; these threads come away about the tenth day. If all the silk threads have been properly secured, there is no bleeding of any importance, but usually there is a little oozing from the cut edge of the vaginal walls. Any bleeding points should be secured and tied.

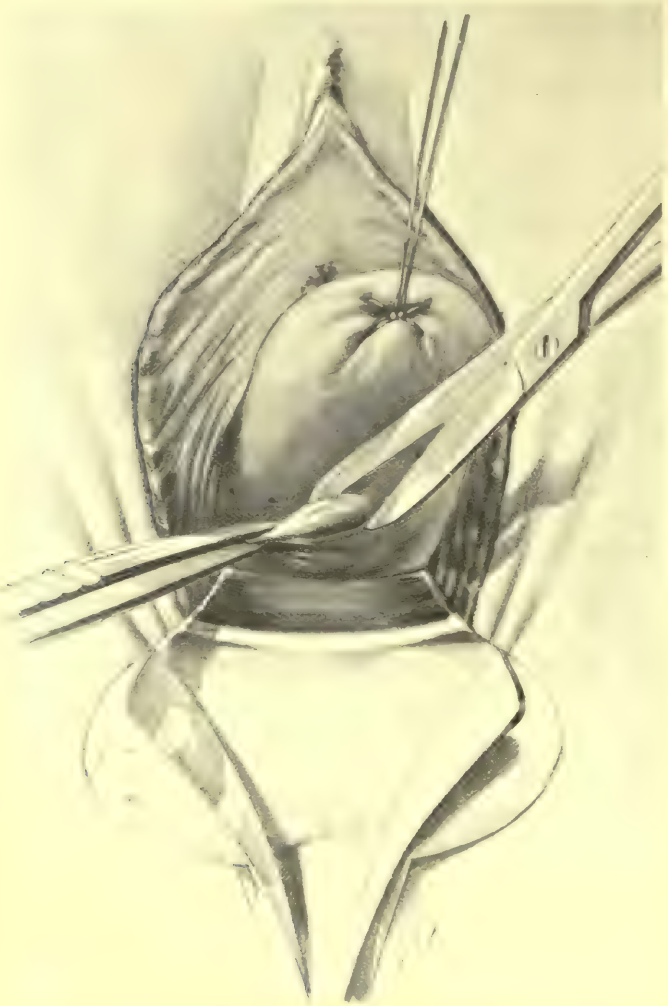

FIG. 156.—Vaginal hysterectomy. (Second stage.)
Opening the recto-vaginal pouch.

There is at this stage a wide opening from the vagina into the peritoneal cavity, and to diminish this opening and so lessen the tendency to descent of the bowel, it is a good plan to pass a suture on each side first through the anterior vaginal wall and the anterior peritoneal edge, then through the posterior peritoneal edge and the posterior vaginal wall (Fig. 161). When the suture is tied it not only diminishes the size of the opening but also closes in the cellular tissue round the margins. Finally a strip of gauze is carried up through the constricted vaginal opening so that the end of it lies just within the peritoneal cavity.

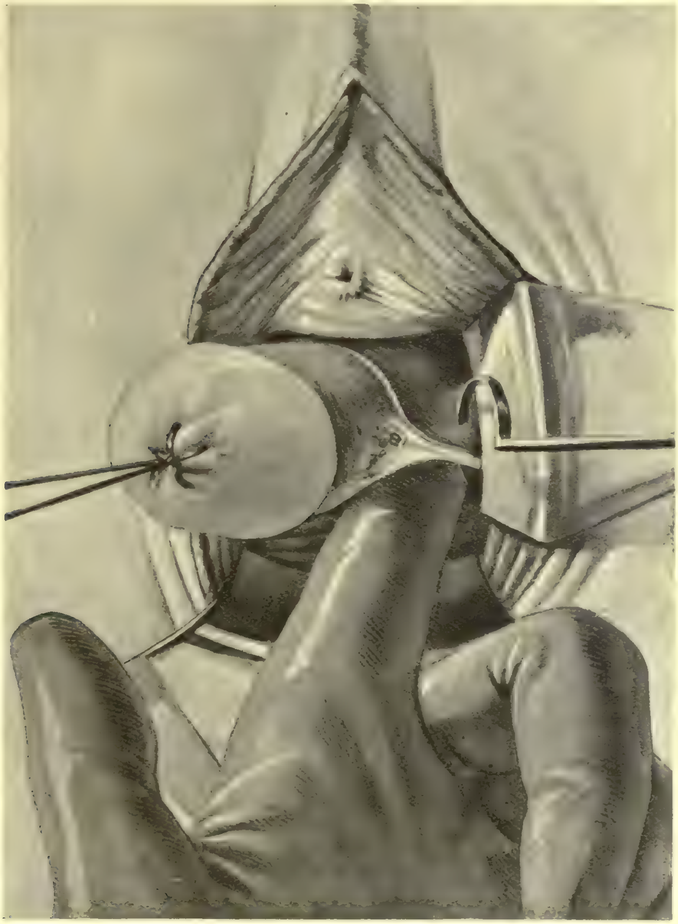

Fig. 157.—Vaginal hysterectomy. (Third stage.)
Transfixion of base of broad ligament, above uterine artery.

In virgins, and when the vagina is narrow, it is sometimes necessary to divide the perineum and even incise the vaginal wall vertically in order to secure room for manipulations.

Variations of Method.—*The Use of Haemostatic Clamps.*—Some operators do not employ ligatures on the broad ligaments. Stages 1 and 2 are carried out as described ; but in Stage 3 a special broad-ligament clamp is introduced, one blade in front of the broad ligament and the other behind. The blades are long enough to project beyond the upper part of the broad ligament, and when they are approximated, the whole broad ligament is securely held. With the scissors the tissues are divided all the way up between the clamp and the uterus. In other cases, instead of one long clamp two shorter ones are used on each side, the first securing the lower part of the broad ligament, and the second its upper part.

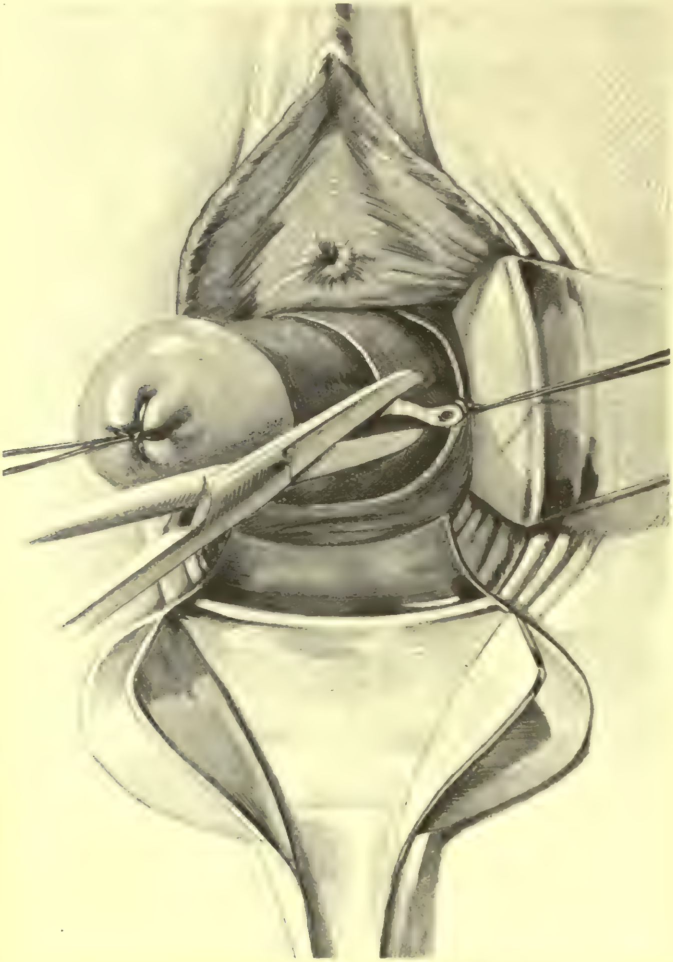

FIG. 158.—Vaginal hysterectomy. (Third stage.)
Division of base of broad ligament, after ligature of the uterine artery.

It is claimed that the use of clamps shortens the duration of the operation and avoids a certain amount of sloughing associated with the separation of the ligatures. The drawback of the method is that when the clamps are removed at the end of forty-eight hours there is a certain risk of haemorrhage. To lessen this risk it is customary when removing the clamps to loosen them and wait a minute or two before withdrawing them. Any haemorrhage, when the clamp is loosened, would be the signal for tightening it again and leaving it *in situ* for another twenty-four or forty-eight hours.

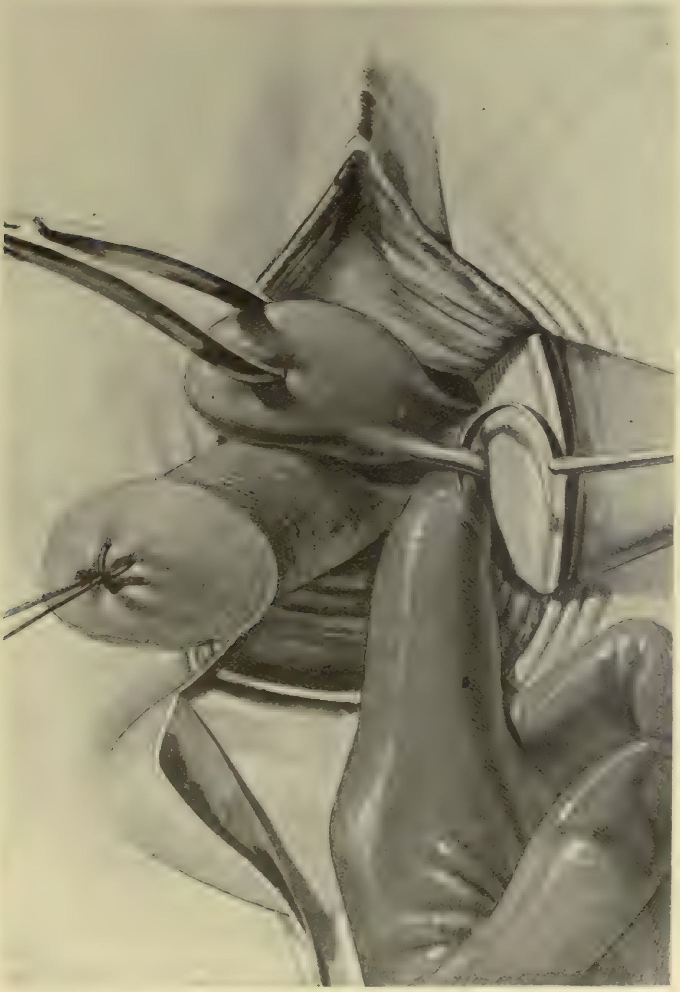

Fig. 159.—Vaginal hysterectomy. (Fourth stage.)
Delivery of the fundus into the vagina, and transfixion of the upper part of the broad ligament.

Hemisection of the Uterus.—When one broad ligament has been completely divided, it is always much easier to deal with the remaining one, by which the uterus hangs as by a pedicle. This fact is taken advantage of in some cases where the narrowness of the vagina or the size of the uterus makes manipulations difficult. The uterus can be split in halves vertically, and if the division is done exactly in the middle line there is hardly any bleeding. The division is done with the scissors after the peritoneal cavity has been opened in front of and behind the uterus. Each half of the uterus is then attached by its corresponding broad-ligament pedicle, which can be secured with comparative ease. This method is not suitable in cases of carcinoma. *Morcellement* may be said to be a further extension of the principle of hemisection, but, as we have said, this method is extinct. The safety of the modern abdominal hysterectomy for fibroids makes uterine morcellement unjustifiable.

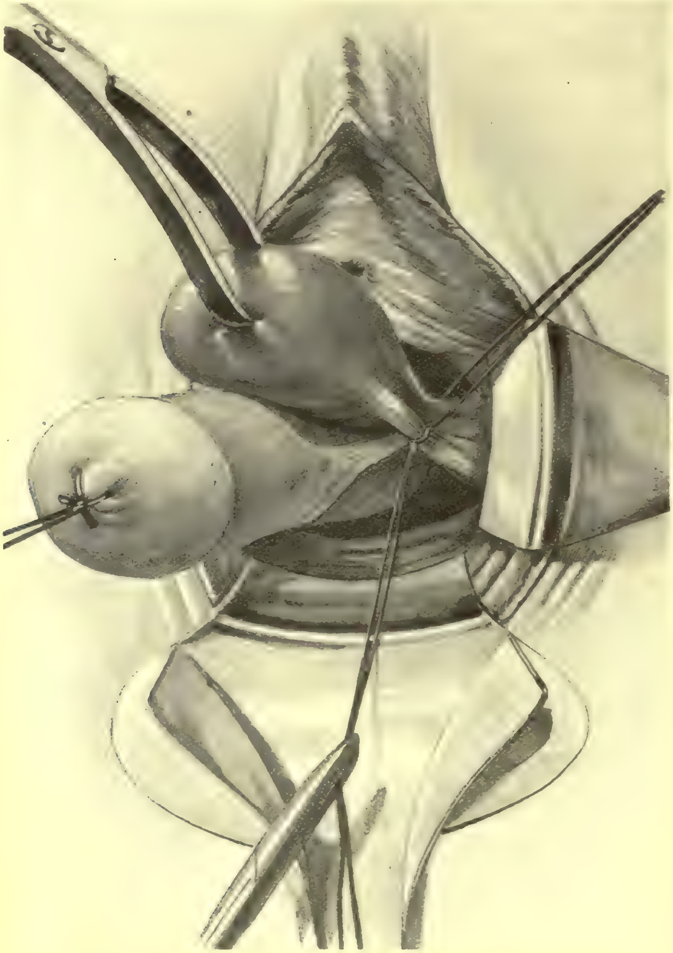

Fig. 160.—Vaginal hysterectomy. (Fourth stage.)
Ligature of the upper part of the broad ligament in two portions.

Vaginal Hysterectomy by Paravaginal Section.—This operation, originally devised by Schuchardt, is more often associated with the name of Schauta, who adopted and improved it. The principle of it is to obtain more room for manipulation by means of an incision carried down through the left side of the vagina and the pelvic floor.

Cases suitable for Paravaginal Section.—The operation is a difficult one for the operator and a formidable one for the patient, and its scope is virtually limited to cases of carcinoma of the cervix in which the patient is so stout that an abdominal operation presents exceptional difficulties. Even so, most surgeons who are experienced in abdominal operations will prefer the suprapubic route. The 'paravaginal incision,' which gives the method its name, is a vertical incision beginning in the left vaginal vault and carried down through the left vaginal wall and para-

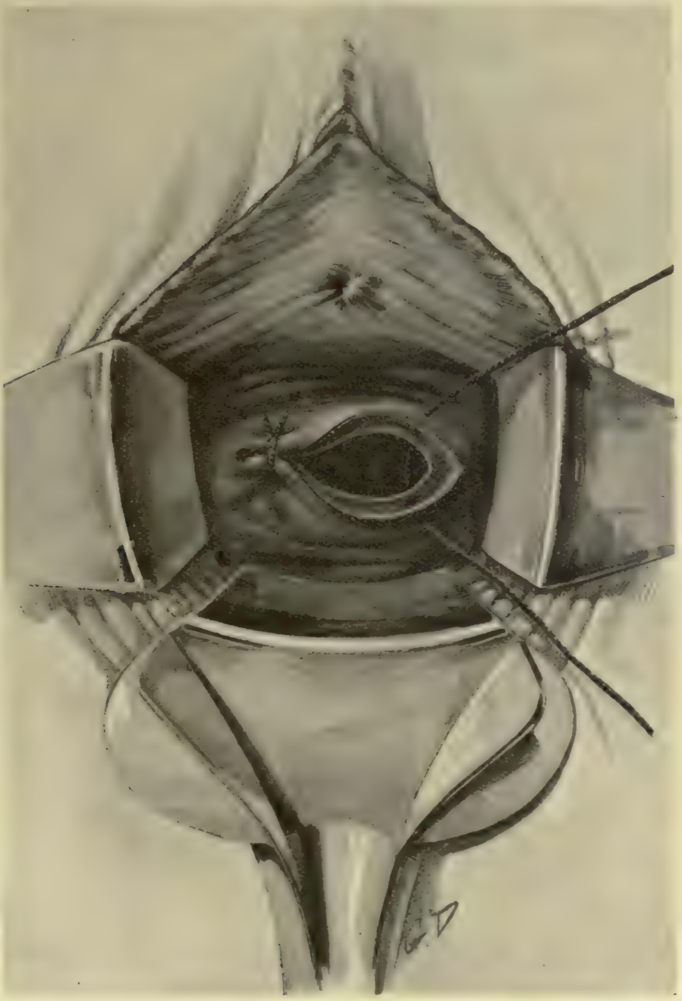

Fig. 161.—Vaginal hysterectomy. (Last stage.)
Partial closure of the opening in the vaginal vault.

vaginal tissue, the left labium, the left levator ani and coccygeus, and the perineum to the left of the median line, the incision passing at the side of the anus back to the sacrum (Fig. 162). Numerous bleeding points must be secured and ligatured. The vagina is next divided transversely at the junction of its upper and middle third, and the portion of the vagina above this incision is dissected off the rectum and bladder in the form of a cuff, the open transverse and vertical edges of which are then sutured over the cervix so as to shut off the cancerous area from the field of operation. The ligatures used for this purpose are left long, to serve as tractors. The bladder and

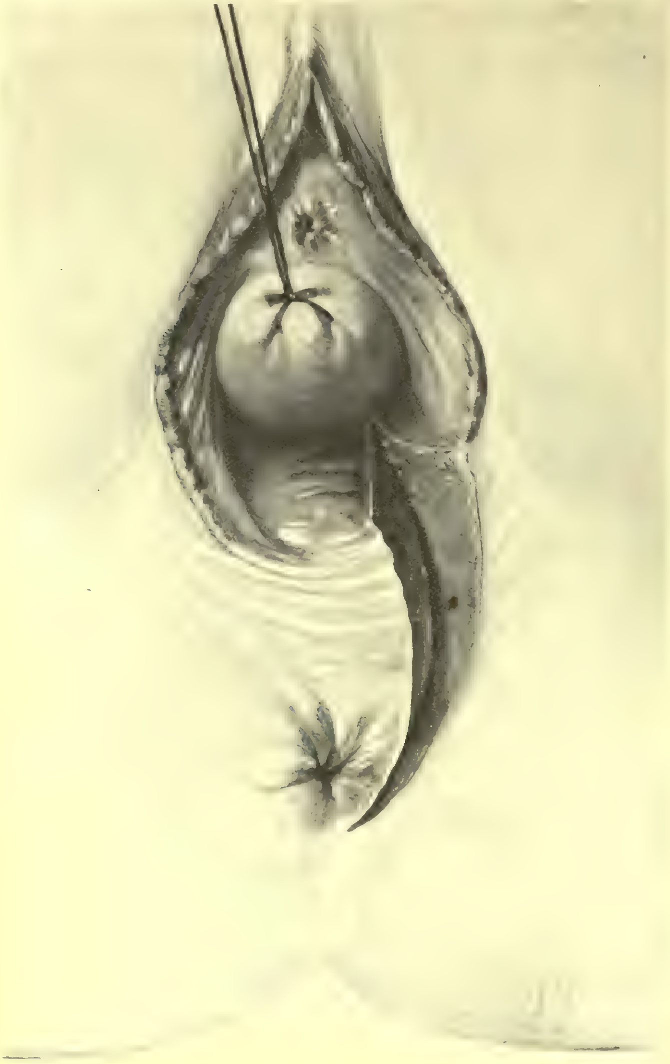

FIG. 162.—The incision in paravaginal section.

uterus are separated from the cervix by careful dissection and by ‘ sponging ’ them off the cervix by means of a swab. When the level of the internal os is reached the utero-vesical fold of peritoneum is divided. By means of dissection behind the cervix the rectum is next separated from the cervix, and the pouch of Douglas is opened up. The uterine arteries and the tissues of the broad ligament are secured and divided as previously described, and the uterus is removed with as much of the parametrium as possible. The peritoneal flaps are united with a fine continuous suture, so as to shut off the peritoneal cavity, and all that now remains is to bring together the cut edges of the paravaginal incision by means of a series of ligatures. A strip of gauze is left in the vagina.

Some operators dissect up the cuff of vagina before making the paravaginal incision ; and sometimes the cuff is made to consist, not of the upper third of the vagina, but of the whole of it.[1]

B. Abdominal Hysterectomy

1. Subtotal or Supravaginal Hysterectomy.—*Cases suitable.*—Briefly we may say that subtotal hysterectomy is the method of choice in all cases in which the disease is non-malignant and the cervix is healthy. It is therefore applicable to fibroids, fibro-adenoma, and fibrosis of the uterus ; and to cases in which hysterectomy is required on account of functional disorder or malformation of the vagina, or on account of implication of the uterus in inflammatory conditions or non-malignant tumours of the adnexa.

Instruments required.—Scalpels; scissors; dissecting forceps; artery forceps (one or two dozen); volsella; ovum forceps; self-retaining abdominal retractor; swab-holders; curved and straight needles and needle-holder; suture material.

To avoid repetition we may say here that for all varieties of abdominal hysterectomy the Trendelenberg position is required.

Steps of the Operation.—The abdomen is opened by a median vertical incision extending from the umbilicus to the pubes. With a large tumour or a very stout patient it may be necessary to extend the incision upwards. The uterus is withdrawn through the incision, or held forwards, and a large flat swab inserted. For this purpose gauze is very unsatisfactory, as it crumples up and fails to hold the bowels back properly. The best thing is a swab eight to ten inches square, composed of Gamgee-tissue sewn round the edges, or of a gauze bag containing cotton wool ; and the most efficient way of placing it is to have it lying diagonally, with one corner tucked down into the pouch of Douglas, the opposite corner lying under the abdominal wall above the incision, and the lateral corners spreading out under the sides of the incision. With this arrangement, the bowel need not be handled or seen during the whole operation. The self-retaining retractor is introduced, and opened as wide as it will go.

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[1] This procedure is further described and illustrated in connection with the operation of excision of the vagina for cancer (Vol. II. p. 66).—Editors.

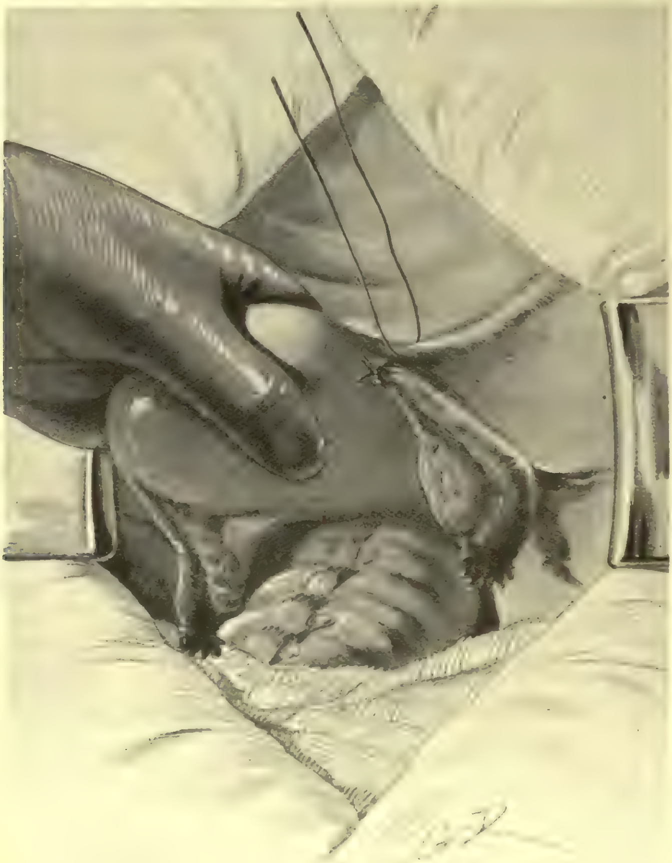

FIG. 163.—Abdominal hysterectomy. (First stage.)
Ligature of the round and the broad ligaments when the ovary is to be preserved.

Stage 1. The assistant draws the uterus over to his side (the left). The operator seizes the right ovary and tube between his finger and thumb and passes a needle, armed with stout silk, through the broad ligament. If the ovary is to be preserved, the silk is tied between the ovary and the uterine cornu, and must include the ovarian ligament (Fig. 163). If it is to be removed, the assistant draws the ovary and tube towards him, and the silk is tied on the outer border of the broad ligament, so as to embrace the ovarian artery (Fig. 164). A second ligature is passed under the round ligament, near the uterus when the ovary is to be preserved, farther away when it is to be removed. A third ligature is passed through the broad ligament in such a way that when it is tied it encircles the other two (Fig. 165); it is called the encircling ligature and is used as a safeguard against slipping of the other ligatures. All the ligatures are left long, and held in a forceps. The broad ligament is now divided, preferably with the scalpel, starting about 1 cm. on the uterine side of the ligatures, the line of division extending in the direction of the internal os (Fig. 166); having reached the side of the uterus, it is carried forwards over the front of the cervix just above the line of reflection of the bladder, and backwards across the posterior surface of the cervix, at a corresponding level (Fig. 167). These incisions mark the upper limits of the cervical flaps. The posterior incision must be made very lightly,

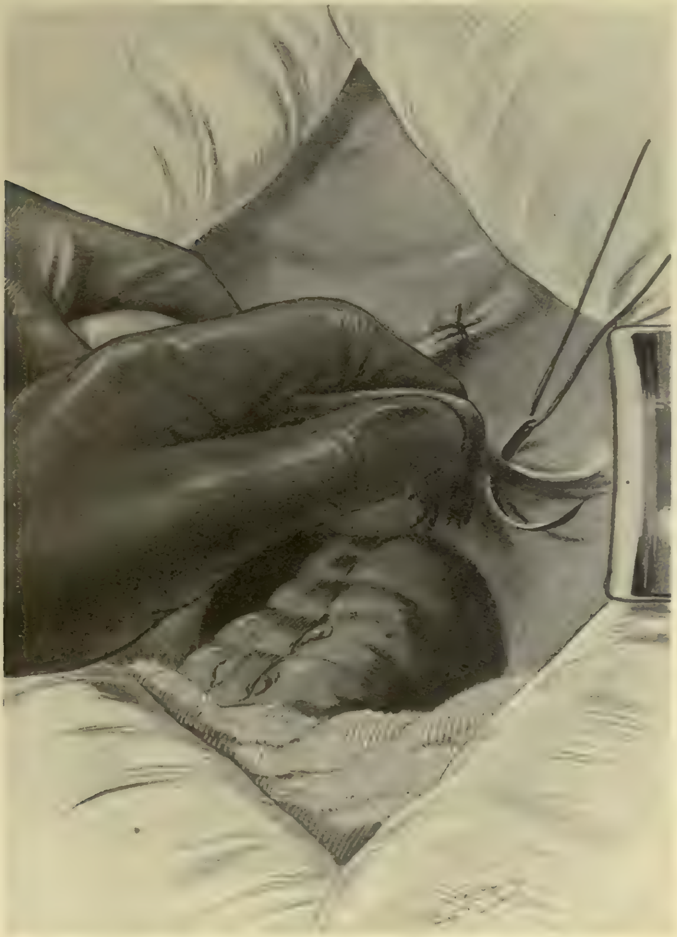

Fig. 164.—Abdominal hysterectomy. (First stage.)
Ligature of the round and the broad ligaments when the ovary is to be removed.

as the uterine artery lies close underneath, and must not be wounded prematurely. The side of the uterus is now exposed, with the uterine vessels running in a vertical direction ; a forceps is placed on the vessels in such a way that the peritoneal flaps are not included in it (Fig. 168).

Stage 2. The left side is dealt with in exactly the same way as the right, and the incisions carried forward and backward from the broad ligament around the cervix complete the demarcation of the cervical flaps.

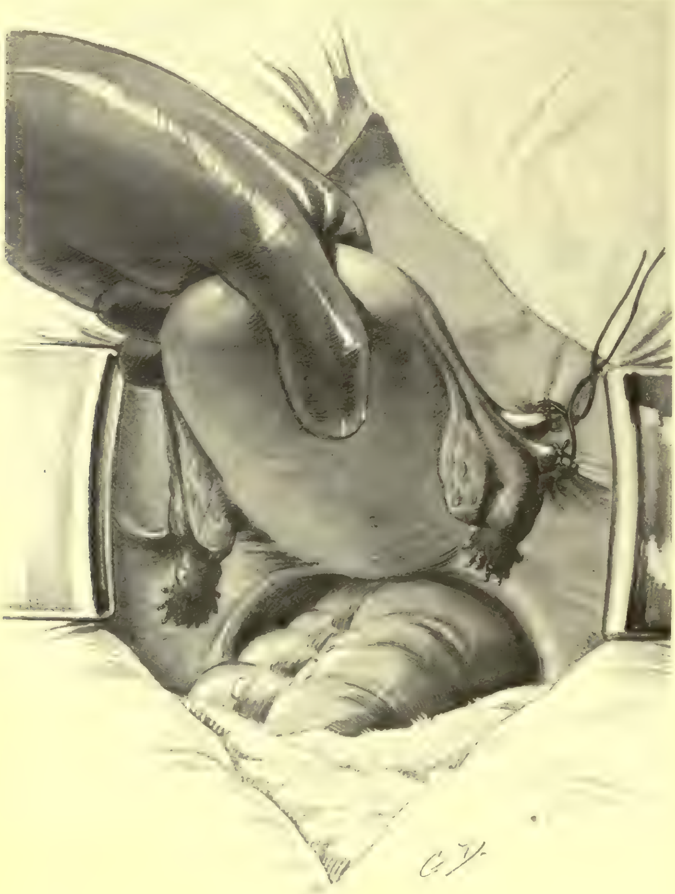

FIG. 165.—Abdominal hysterectomy. (First stage.)
The encircling ligature round the ligatures on the round and the broad ligaments.

Stage 3. The uterus is now amputated by carrying the scalpel across the cervix from behind forwards and downwards, and from in front backwards and downwards, the lower end of the amputated portion being thus somewhat V-shaped (Fig. 169). The incisions divide the uterine vessels. Before the division is completed the anterior portion of the cervical stump should be picked up with the volsellum, but without including the peritoneal aspect of the flap.

Stage 4. The uterine artery is tied on each side, the ligatures being cut short.

Stage 5. The next thing is to bring the flaps into apposition over the stump, by means of two mattress-sutures. These are passed as follows: a curved needle armed with a good length of stout silk is passed through the anterior flap, from before backwards, just to the left of the median line, and about a quarter of an inch from the edge of the flap; it is then made to transfix the posterior flap from before backwards, also about a quarter of an inch from the edge. The needle is returned through both edges of the broad ligament, this time from behind forwards, just

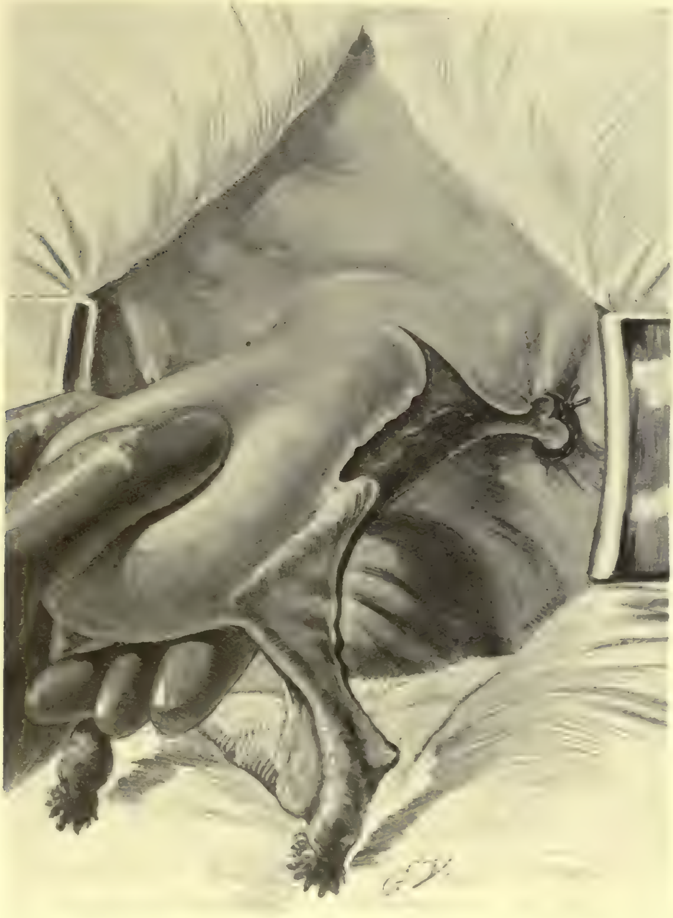
FIG. 166.—Abdominal hysterectomy. (First stage.)
Division of the broad ligament up to the side of the uterus and of the peritoneum in front of the cervix.

external to the place where the uterine artery has been tied ; and the suture is tied in such a way that the artery is embraced within it, and so additionally secured. A corresponding suture is passed and tied on the right side (Fig. 170). The volsellum is removed, and the mattress-sutures being left long can be used as a tractor.

Stage 6. All that remains is to bring the peritoneal edges accurately together over the face of the stump, from one ovarian pedicle to another (Fig. 171). This is done by means of a long suture of fine silk, tied in a curved needle ; the needle is first passed through the anterior and posterior edges of the peritoneum just internal to the left ovarian pedicle, and a continuous suture runs along the edges, till it is tied off just internal to the right ovarian pedicle.

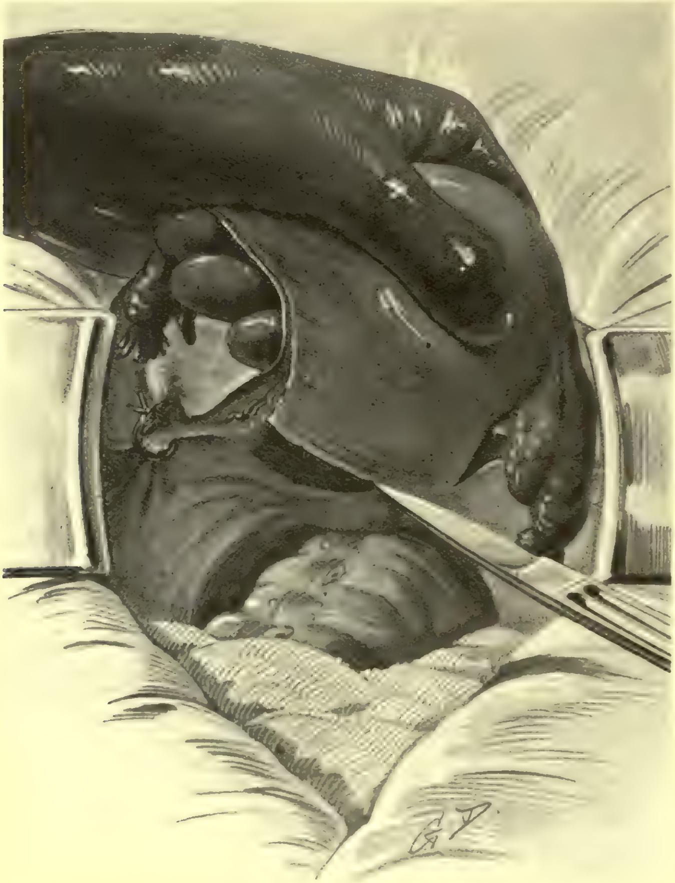

Fig. 167.—Abdominal hysterectomy. (First stage.)
Division of the peritoneum on the posterior aspect of the cervix.

All the sutures are now cut short ; the abdominal swab is removed ; the pelvis is gently irrigated with normal saline solution, and sponged dry. The omentum is brought down so as to cover the small intestine, and the abdominal wound is closed by three layers of sutures, the first, of fine silk, uniting the peritoneal edges by a continuous suture; the second, of stout silk, uniting the muscle and fascia by interrupted sutures; whilst a continuous suture of fine silk for the skin edges completes the operation.[1]

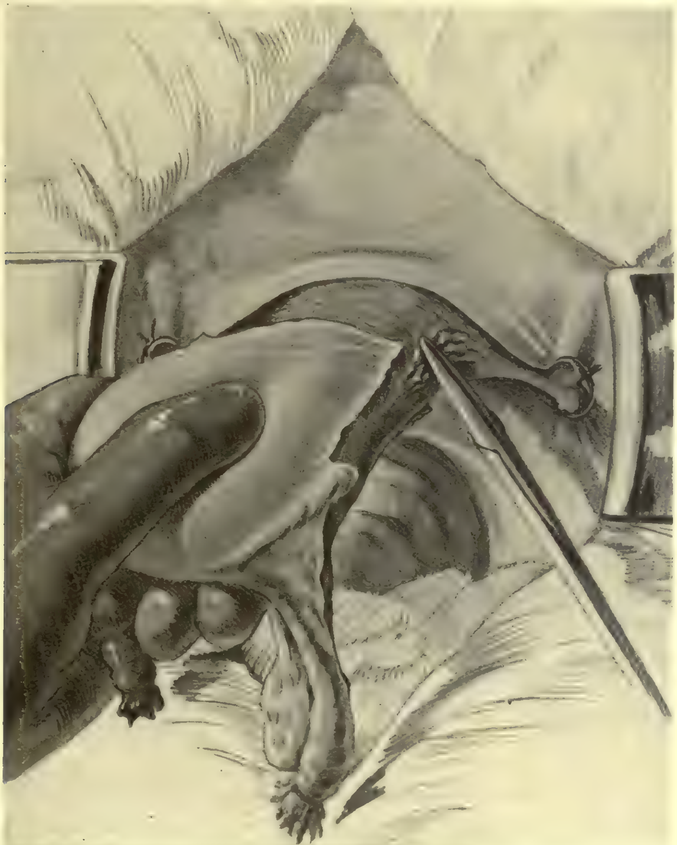

FIG. 168.—Abdominal hysterectomy. (First stage.)
The securing of the uterine vessels.

2. Total Hysterectomy or Panhysterectomy.—*Cases suitable.*—Total hysterectomy is the only procedure applicable to carcinoma or sarcoma of the body of the uterus, to uterine tuberculosis, and to some cases of cervix-fibroid, and it is the method of choice with uterine fibroids and fibrosis, when the cervix is unhealthy or arouses suspicion of the possibility of the development of malignant disease. Some operators advocate it in all cases.

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[1] The Editors desire to point out that the great majority of operators prefer catgut to silk for this operation. See also Article on Technique (p. 303).

The question of total versus subtotal hysterectomy as the method of choice will be dealt with in a later paragraph. The particular method which is here described is especially applicable to cases of fibroids and other benign conditions, for which, indeed, it may be regarded as the standard method of total hysterectomy.

Instruments required are the same as for subtotal hysterectomy.

Steps of the Operation.—*Stages* 1 and 2 are as already described.

Stage 3. The uterus is drawn up as far as possible, and with the scalpel, shallow incisions are made round the cervix, at the front, back, and sides. By repeating these incisions while the traction on the uterus is maintained, a thin shell of the *outer wall of the cervix* is left behind, and the core of the cervix is removed with a circle of the vaginal mucosa surrounding the external os (Fig. 172). By this means the whole of the uterine mucosa is removed; and as the cutting is done within the cervical tissues there is no risk whatever of injury to the bladder and ureters. During the dissection the anterior part of the anterior wall of the cervix is seized with the volsellum, and when the dissection is complete the vaginal cut edges in front and behind are caught with pressure-forceps. A small swab, dipped in 2 per cent iodine solution, should be passed down just into the vagina, and the margins of the incision swabbed over.

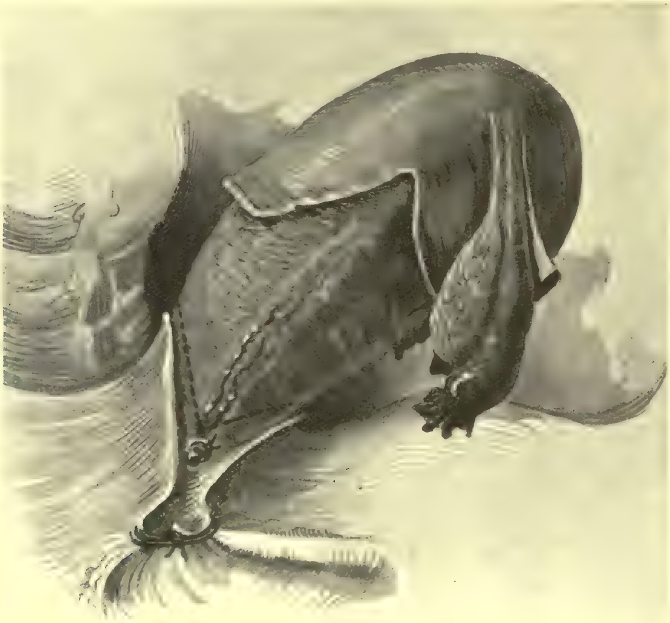

Fig. 169.—Abdominal hysterectomy. (Third stage.)
Semi-diagrammatic lateral view of the uterus to show the V-shaped incision by which the uterus is amputated.

Stage 4. The uterine arteries are tied; and one or two small cervical branches on the lateral cut face of the cervical capsule will probably require to be ligatured separately.

Stage 5. The flaps are brought into apposition by means of mattress-sutures. They must be passed with great care as follows: the needle is passed from before backwards through the anterior peritoneal flap, a little to the left of the middle line, and is then made to pierce the anterior face of the cervical wall, emerging at the vaginal edge; the posterior flap is dealt with in the same way, beginning at the posterior vaginal cut edge, picking up the posterior cut face of the cervical wall and transfixing the posterior peritoneal flap from before backwards. The needle is returned through the peritoneal edges of the broad ligament, from behind

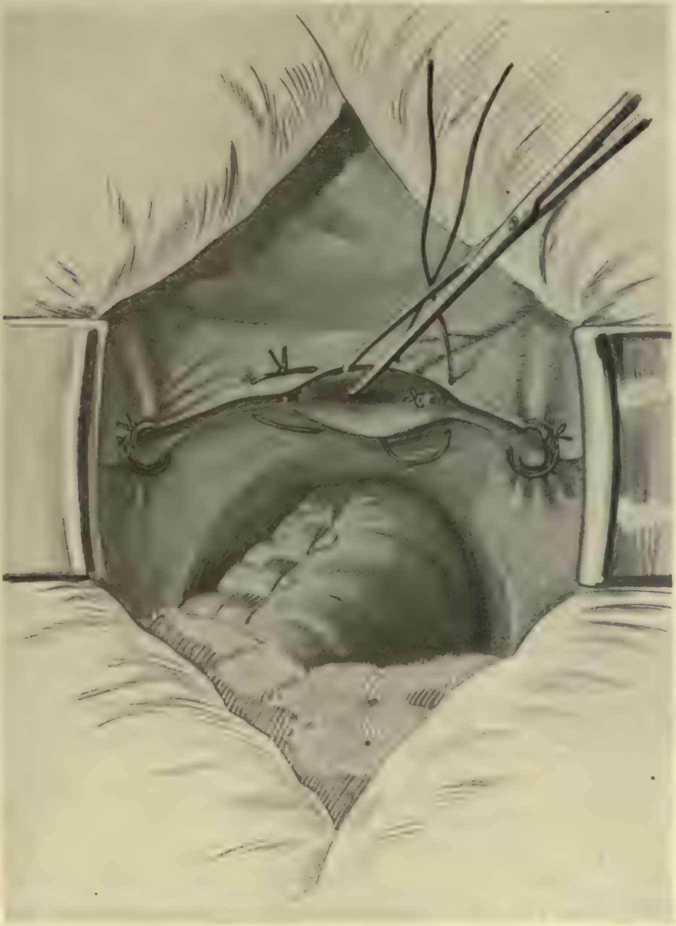

Fig. 170.—Abdominal hysterectomy. (Fifth stage.)
The mattress-sutures in the cervical stump; the left one has been tied.

forwards, external to the left uterine artery. The ends of the suture are held in a forceps until the corresponding mattress-suture has been passed on the right side. During the tying of each of these sutures the outer angle of the vaginal cut edge should be picked up with forceps, so as to include all the lateral vascular zone of the cervical wall within the embrace of the suture; this will lessen the risk of haemorrhage subsequently from the cervical and vaginal cut edges.

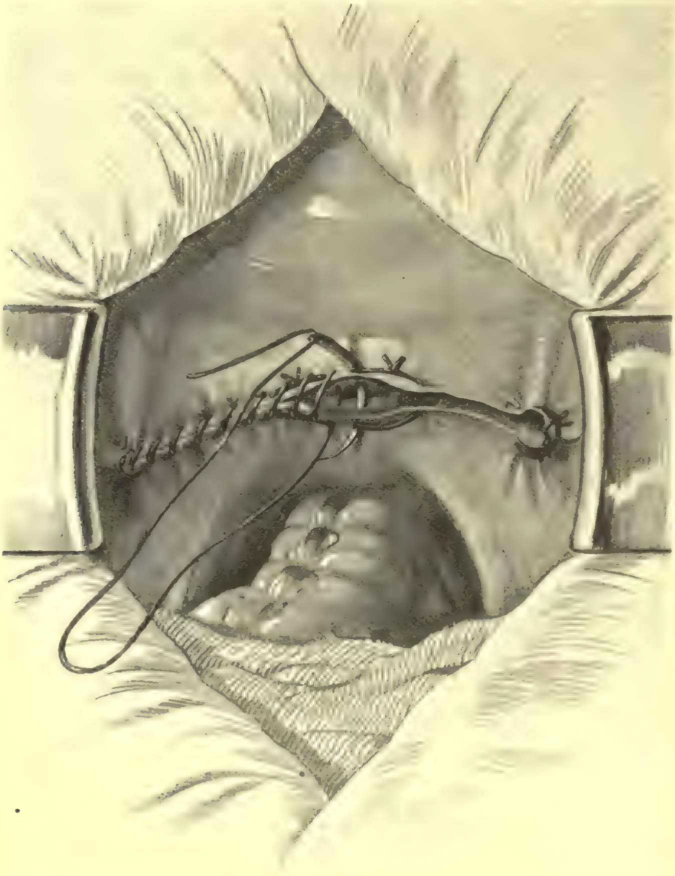

FIG. 171.—Abdominal hysterectomy. (Final stage.)
The sewing together of the peritoneal edges along the broad ligaments and over the cervical stump.

Stage 6 and the completion of the operation are as before.

Variation of the Method.—Instead of removing the uterus and cervix in one piece as described, it is sometimes more convenient to amputate the uterus as for a subtotal hysterectomy, and then dissect out the conical cervical core from the stump of the cervix. This variation is specially applicable to cases where the uterus is so large as to obscure the view, or interfere with the delicate manipulation of the dissection of the cervical core, but it should never be adopted in cases of actual or suspected malignant disease.

Subtotal versus Total Hysterectomy as the Method of Choice.—The advocates of total hysterectomy base their arguments on the possibility of the development of malignant disease subsequently in the cervical stump ; they say that while the body of the uterus is being removed it is a simple matter to remove the cervix also, and so save the patient from a risk which, though small, is nevertheless real. They recall the cases in their own practice and in that of others, where such a malignant development has actually taken place, necessitating a second operation for the removal of the cervix *per vaginam.*

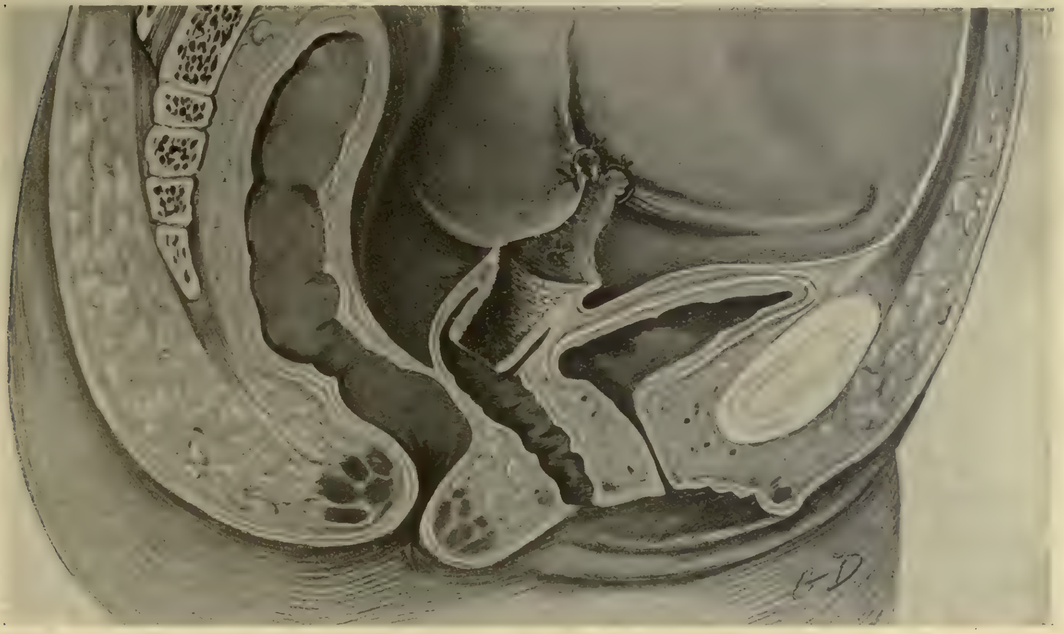

Fig. 172.—Panhysterectomy.
Semi-diagrammatic representation of the shell of the outer wall of the cervix, left after removal of the core of the cervix with the mucosa.

The advocates of subtotal hysterectomy admit the possibility of the subsequent development of malignant disease in the cervical stump, but they say that the frequency of such a complication has been greatly over-estimated, and that, by a judicious selection of cases the risk can be reduced to an infinitesimal one. They point out that carcinoma of the cervix is practically unknown in nulliparae ; and that if total hysterectomy be adopted in all cases where the condition of the cervix is doubtful, subtotal hysterectomy can be done with great safety in the other cases.

But there is another question: Has subtotal hysterectomy any definite advantages over the total method? If not, there can be no question that however small the risk of malignant development might be, it would never be worth while incurring it. But the advocates of the subtotal operation claim that it has definite advantages: (1) the operation is easier and quicker; (2) there is less risk of haemorrhage from the stump; (3) the genital tract is cut across in the region of the cervix, which is usually sterile, instead of in the region of the vagina which commonly contains pathogenic organisms; (4) the presence of the cervical stump strengthens the vaginal vault, and the vagina is undisturbed—a point of some importance in the case of married women; (5) there is less risk of injury to the bladder and ureters in the subtotal operation.

Personal experience leads me to adopt the conclusion that total hysterectomy is indicated in certain definite conditions, but that with a healthy cervix, especially in nulliparae, and in the absence of malignant disease, subtotal hysterectomy is the method of choice.

The procedures above described may be regarded as the standard methods of subtotal and total hysterectomy. We have now to describe some different methods, some of which are suitable in special cases.

3. Special Methods of Hysterectomy.—(*a*) *Kelly's Subtotal Hysterectomy, by Continuous Incision from Left to Right or from Right to Left.*[1]—While this method is applicable in most cases of uterine fibroids, it was devised more particularly for the purpose of dealing with certain cases of intraligamentary fibroids, and with some conditions of tubo-ovarian inflammation. Kelly ligates the broad ligament on one side and separates the vesical peritoneum. After tying the corresponding uterine artery " the cervix is cut completely across just above the vaginal vault, severing the body of the uterus from the cervical stump, which is left below to close the vault. As the last fibres of the cervix are severed, while the body of the uterus is being drawn up and rolled out in the opposite direction, the other uterine artery comes into view and is caught with an artery forceps (Fig. 173). Rolling the uterine body still farther out, the round ligament is clamped at the pelvic brim, next the ovarian artery is secured, and the removal of the whole mass, consisting of uterus, tubes, and ovaries, is completed."

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[1] H. A. Kelly, " Hysteromyomectomy by Continuous Incision from Right to Left, etc.," *Johns Hopkins Hospital Bull.*, 1896, vol. vii. Nos. 59 and 60, p. 27.

(*b*) *Doyen's Panhysterectomy.*[1]—This operation was introduced as an alternative to the standard method, and some surgeons practise it, but the majority of operators consider it to be inferior to the standard method. The uterus is drawn well up through the abdominal incision and held forward. The posterior vaginal fornix is opened; the cervix is seized with tenaculum forceps and drawn upwards through the vaginal opening (Fig. 174), and strong traction is made on it while it is cut away from the vaginal walls laterally and in front. It is claimed that in this way the cervix can be stripped easily from the bladder. The vesico-uterine fold of peritoneum is now divided, the uterine arteries are clamped and divided, and finally the broad ligaments are divided close to the uterine cornua and the insertion of the round ligaments. The ovaries and tubes are removed or preserved according to their condition.

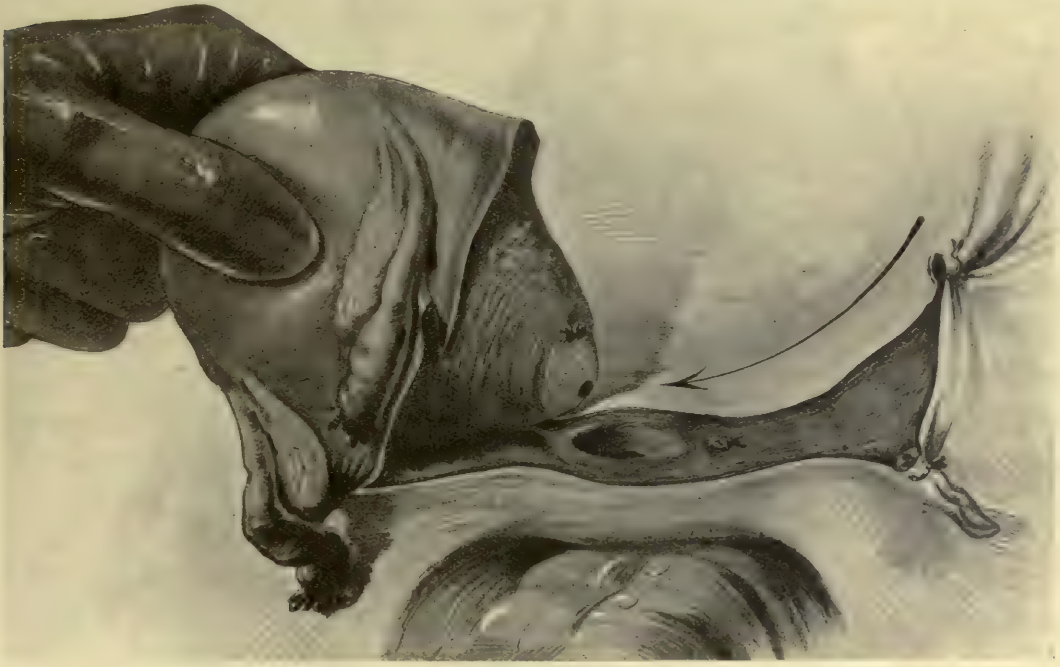

Fig. 173.—Kelly's method of hysterectomy by continuous incision from right to left. (After Howard Kelly.)

(*c*) *Pryor's Total Hysterectomy.*[2]—This may be described as a combined modification of Kelly's and Doyen's methods. A continuous incision is made from one side to the other, as in Kelly's plan; but instead of leaving the cervical stump, Pryor opens the vagina upon one side, after securing the corresponding uterine artery; the uterus is then tilted over to the opposite side, the other lateral vaginal wall is divided, the uterine artery secured, and the operation completed as it is by Kelly's method.

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[1] E. Doyen, "Hystérectomies Abdominales," *Arch. prov. de Chir.* vol. i. No. 6, December 1892, p. 494.

[2] Wm. R. Pryor, "A New and Rapid Method of dealing with Intraligamentous Fibromata," *Med. News*, 1894, vol. lxv. p. 602.

(*d*) *Kelly's Modifications in certain Atypical cases.*[1]—In some cases of unusual difficulty due to adhesion of bowel or tubo-ovarian inflammation, or where the relations of the vessels are so obscured that their preliminary ligature is very difficult, Kelly proceeds in one of three ways:

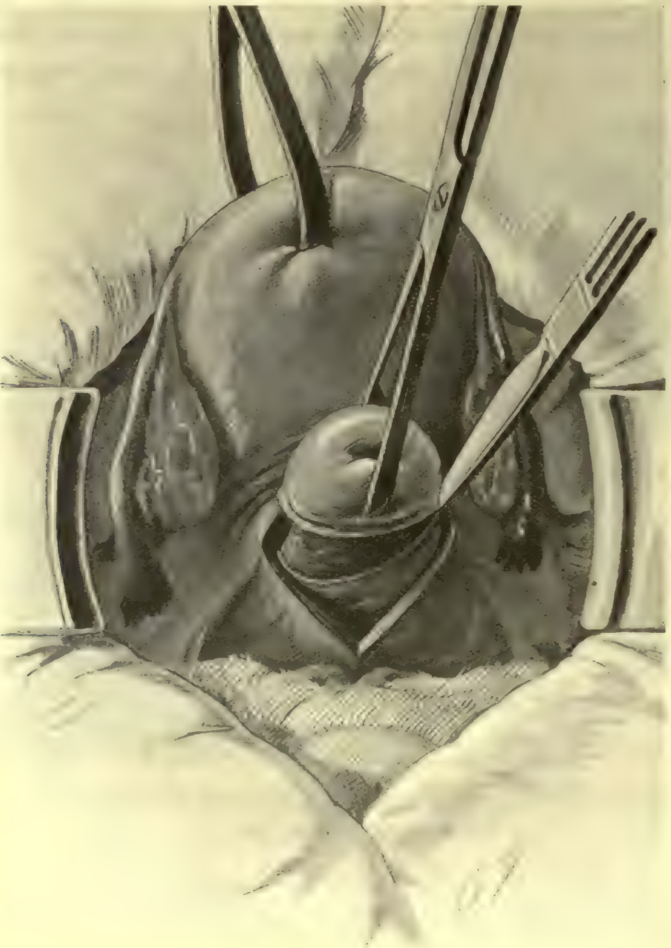

FIG. 174.—Doyen's method of panhysterectomy.
The cervix drawn back and upwards through the opening in the posterior vaginal fornix.

1. By a median sagittal section of the uterus with the tumours. After the

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[1] H. A. Kelly, "The Evolution of my Technique in the Treatment of Fibroid Tumours," *Am. Journ. of Obst.*, 1900, vol. xlii. p. 289.

hemisection, each half is removed by consecutive clamping and division from within outwards, beginning with the uterine artery and finishing with the round ligaments and ovarian vessels.

2. By a bisection of the tumour alone.

3. By a coronal bisection of the uterus in its cervical part.

The cases calling for these special methods are rare, and the methods themselves are such as only practised operators could carry out satisfactorily; so it is not necessary to describe them here in detail, and we may refer those who wish to make themselves better acquainted with them to Kelly's original communication. We may, however, devote some special observations to the methods of dealing with three types of difficult cases, namely, cervical fibroids, retroperitoneal fibroids, and fibroids complicated by adherent pus-tubes.

(*e*) *Hysterectomy for Cervical Fibroids.*—When fibroids develop in the cervix and attain to a considerable size, they render a hysterectomy difficult in two ways. In the first place the uterus and tumour are held down in the pelvis by their anatomical relations, and consequently, they cannot be drawn up sufficiently to allow of the necessary manipulations; in fact sometimes the uterus cannot even be brought through the abdominal incision. In the second place the mere bulk of the tumour is often such that it completely fills up the true pelvis, and consequently the uterine arteries cannot be reached.

The solution of the problem, how to deal with a cervical fibroid, is after all a simple one. All that is necessary is to enucleate the tumour, which is nearly always a solitary one, before commencing to do the hysterectomy. The uterus can then be drawn up, and the vessels reached with relative ease.

A cervical fibroid lies either in front of the cervical canal, or behind it, or to one side; and the operator must ascertain the position of the tumour beforehand. This is done by introducing the uterine sound and noting whether it passes behind, in front, or to one side of the tumour. It is true that it is often possible to see what is the position of the tumour when the abdominal cavity is opened; but this is not always the case and therefore it is better to be forewarned.

After the abdomen has been opened, the self-retaining retractor introduced, and a large swab put in position behind the uterus in such a way as to cover up the intestines and keep them out of the way, a transverse incision is made through the peritoneum and capsule of the tumour. If the tumour is in front of the cervix, the incision is made in front of the fundus, taking special care to avoid the bladder, which is often pushed up in these cases. If the tumour is behind the uterus, the incision should be made as low down as possible behind the fundus. If the tumour lies to one side, namely in the broad ligament, the incision should be made over its most prominent part. This may be in front of the round ligament, between the round ligament and the Fallopian tube, or behind the tube and ovary.

The capsule being freely incised, the finger is introduced and worked round

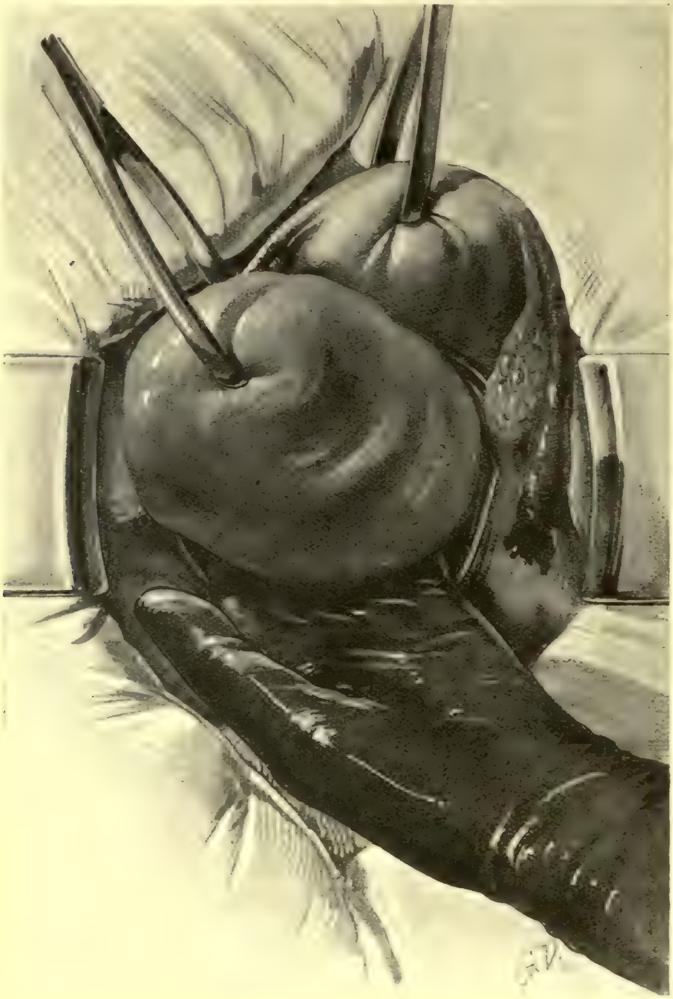

Fig. 175.—The enucleation of a cervix-fibroid from its capsule as a preliminary to abdominal hysterectomy.

between the capsule and the tumour until the latter can be made to project through the peritoneal and capsular incision (Fig. 175); by a little further manipulation the tumour can, if necessary, be shelled out completely. There is seldom any bleeding beyond a little venous oozing during this part of the operation. The uterus (with the tumour, if this has not been shelled out completely) can then be raised sufficiently out of the pelvis to allow of the operation being carried out on the general lines laid down ; that is, the consecutive ligature and division of the broad ligament and the exposure and clamping of the uterine vessels, first on one side and then on the other. The question of the removal of the ovaries will depend, not only on their healthiness or otherwise, but also on their position ; sometimes they are drawn up with the fundus so high above the tumour that it is advisable to remove one or both of them, even when healthy. The points that require special attention are, first, the care of the bladder when the tumour is in front of the cervix, and secondly, the care of the ureter when the tumour lies in the broad ligament. In the latter case, the finger must be kept very close to the tumour during the process of enucleation.

(*f*) *Hysterectomy for Retroperitoneal Fibroids.*—The pelvic peritoneum may be stripped up in various positions. As we have indicated, a cervical fibroid, which is nearly always a solitary tumour, may strip up the peritoneum in front of the uterus, carrying the bladder with it ; or it may strip up the peritoneum of the broad ligament. But there are fibroids that grow out, either at the sides of the uterus or behind it, which may raise the floor of the pouch of Douglas, or grow out within and beyond the broad ligaments, opening up the meso-sigmoid on the left side, and extending far enough up on the right side to open up the meso-caecum. Some of these cases are among the most formidable that we are called upon to deal with ; because the relations are so distorted that at first they cannot be recognized even in broad outline ; and it may be impossible even to draw up the appendages sufficiently to allow of the passing of the necessary ligatures. A further difficulty is due to the fact that while the tumours are being freed and enucleated there is apt to be a great deal of venous oozing which obscures the field of operation. There is little use in trying to stop this oozing ; an attempt to do so will inevitably lead to a great waste of time, and eventually to a much greater loss of blood. Consequently the guiding principle must be to get the tumours out with such rapidity as is consistent with a scrupulous care to avoid damaging the bladder, bowel, or ureters.

It is best to begin by securing the ovarian vessels when this is possible, and the round ligaments should be tied or clamped ; then the broad ligaments can be opened up from the outer side, and at once it will be possible to raise the uterus and tumours a little farther out of the pelvis. The next step is to divide the peritoneum transversely in front of the uterus and push the bladder down out of harm's way. When the meso-caecum or meso-sigmoid is spread out by the tumours, the peritoneum should be incised as far as possible from the bowel, remembering that the vascular supply enters on the median side, and the tumour then enucleated. A line generally transverse should be aimed at in making these incisions, so that suitable peritoneal flaps may eventually be available for covering up the pelvic floor. Furthermore, the enucleation should be carried out in such a way as to aim at reaching the sides of the uterus in order to secure the uterine arteries. Once this object is attained there is no longer any fear of serious haemorrhage. Sometimes the operator must abandon all preconceived ideas, and proceed along the lines that offer the best prospect. Thus in some cases Kelly's method of continuous incision from one side to the other is very useful. In a recent case that the writer had to deal with there were dense bowel-adhesions behind the tumours, the left broad ligament was stripped up so as to open up the meso-sigmoid, and on each side there was an ovarian cyst adherent to the floor of the pelvis, the left one suppurating. After the right ovarian artery and the right round ligament had been secured and divided, the bladder was separated from the front of the uterus and an incision was made across the cervix from in front; this exposed the uterine arteries, which were seized as they spurted, and the division of the cervix was then completed. From this point it was possible to work out to the sides until the whole mass was freed. In effect, the method adopted was on the lines indicated in a previous paragraph under the heading of "Kelly's modifications in certain atypical cases," namely, his third plan, of coronal bisection of the uterus in its cervical part. In some cases the first plan there mentioned, that of a median sagittal section of the uterus with the tumours, might be adopted.

When there is a single retroperitoneal fibroid, in whatever position, the plan to be adopted is that of making a transverse incision through the peritoneum in its most prominent part, and enucleating the tumour in the same way as is done with cervical fibroids.

In all cases of fibroids lying under the peritoneum at the sides of the uterus, the ureter must be watched for with the greatest care, because it is apt to be displaced from its normal position at the base of the broad ligament, and may even be raised so that it runs superficial to the tumour.

(*g*) *Hysterectomy for Fibroids complicated by adherent Pus-tubes.*—In such cases, although the ovaries and tubes are to be removed, it is difficult to begin by separating the adherent tubes and securing the ovarian vessels at the side of the pelvis. The best course to adopt in these circumstances is to clamp the tube and ovarian ligament and the round ligament close to the uterine cornu, divide the broad ligament close to the uterus and secure the uterine artery, first on one side and then on the other, and amputate the uterus through the cervix. Having thus obtained more room in which to work, the tubes and ovaries can be separated from their adhesions, a forceps placed on the ovarian vessels, external to the tube and ovary, and the inflammatory masses removed. All the vessels are tied, the stump of the cervix is closed over with mattress-sutures, and the peritoneal edges brought together as far as possible. Sometimes the peritoneum on the posterior aspect of the broad ligaments is so stripped and damaged that it is difficult to obtain a good peritoneal investment at the sides of the stump, and some raw surfaces may have to be left.[1]

4. Wertheim's Hysterectomy for Carcinoma of the Cervix.—*Cases suitable* for this method are those of cancer of the cervix in which the growth has not invaded the base of the bladder and the ureters, nor has spread too far down the vagina, nor involved the rectum. Mere extension into the parametrium is not in itself a bar, because one object of the operation is to include as much as possible of the parametrium in the tissues removed.

The percentage of cases deemed operable by different operators varies considerably. Berkeley and Bonney[2] state: "According to Döderlein and Krönig the average percentage operability of ten operators by the radical abdominal method was 68. Wertheim has operated upon 49 per cent of his cases, Schindler 46 per cent, and Bumm 90 per cent; but this latter figure must be due to the fact that Bumm has operated on cases that most other surgeons would refuse—a surmise which is perhaps warranted by his heavy primary mortality. We have noted every case of cancer of the cervix, both in the in- and out-patient departments of the Middlesex and Chelsea Hospitals, and also the private cases that we have seen during 1908 and 1909, and our percentage operability during this period has been 67." The variation in the figures is doubtless due to the fact that some operators judge of the operability of the case by examination only (under anaesthesia if necessary), whilst others, in case of doubt, open the abdomen in order to ascertain whether the bladder is separable or not. It is not always possible to determine this point by examination alone, and therefore those who open the abdomen would find a certain number of cases to be operable, which other surgeons might class as inoperable.

Instruments required.—In addition to those enumerated for ordinary abdominal hysterectomy, some form of vaginal clamp is required. The most convenient types are Eden's, and Berkeley and Bonney's. An aneurysm-needle is also useful in the tracing of the ureters.

Steps of the Operation.—There are two stages at which the operator must make a careful examination for the purpose of deciding whether the case is a suitable one for the radical operation.

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[1] Other methods of dealing with such cases are described in the Article on Inflammatory Affections of the Fallopian Tubes (Vol. I. p. 623).—EDITORS.

[2] *A Text-book of Gynaecological Surgery*, by Comyns Berkeley and Victor Bonney. London, Cassell & Company, 1911, p. 365.

Preliminary Vaginal Examination and Treatment.—The first stage is at the outset, when the patient is placed in the lithotomy position, and the cervical growth is scraped away as far as possible. This allows of a more complete examination which follows two lines of enquiry according to the nature of the growth.

(*a*) In some cases the growth is mainly intravaginal, and does not tend to extend within the cervical canal, except in the late stages. What we require to know is whether the affected area of the vaginal vault can be removed clear of the disease, and whether there is sufficient mobility of the uterus to make it probable that any affected parametric tissue can be got rid of completely.

(*b*) In other cases the growth begins in the cervical canal and spreads inwards. The special danger-zone here is the base of the bladder, and what we require to know is whether the bladder is free or invaded. This can usually be determined by introducing a finger into the cervical canal, from which the growth has been scraped away, and a sound into the bladder; the thickness of the tissue that intervenes between the finger and the sound can then be estimated. Sometimes this tissue is so thinned out that it gives the sensation of being little more than the thickness of a sheet of paper. At other times nodular deposits in the substance of the bladder-wall, involving the mucosa, can be felt. In either case the hope of doing a radical operation must be abandoned. In cases of doubt, valuable information may be obtained by means of the cystoscope.[1]

If a *prima facie* case for proceeding with the operation has been made out, the cervix and vagina are swabbed over with pure methylated spirit, and afterwards with 2 per cent iodine in spirit, and a strip of sterilized gauze is placed in the vagina. Formerly this preliminary treatment was carried out a week before the abdominal operation; and after the scraping, the growth was cauterized. This led to an offensive vaginal discharge, due to sloughing, and the risk of infection was materially increased. It is now considered better to omit the cauterizing and to proceed immediately with the abdominal operation.

Stage 1. The abdomen is opened in the middle line, and this is the second stage at which an examination must be made. By palpation and inspection the operator ascertains whether the growth has invaded the bladder; whether it has spread along the parametric tissues and involved the iliac and aortic glands to such an extent as to preclude the total extirpation of the disease; and whether there are metastatic growths in other parts of the abdomen. In the presence of any of these conditions the operation must be abandoned and the wound closed. When on the other hand the conditions are favourable, the incision is extended in order to obtain plenty of room for working. Often these patients are very stout, and an extra long incision will be required.

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[1] See Article on Methods of Examination of the Urethra and Bladder (p. 126, and Plate IX. Fig. F).—Editors.

A large swab is placed in position to hold back the intestines, and a self-retaining retractor is introduced to hold the wound open. The uterus is drawn well over to the right side, a forceps is placed on the left ovarian artery as high up as possible, and a second forceps on the round ligament at a good distance from the uterus. The broad ligament is divided from a point just internal to the ovarian forceps right up to the side of the uterus, the round ligament being divided at the same time. To keep the field of operation as free from forceps as possible it is well to tie off the ovarian artery and round ligament, remove the forceps, and cut the ligatures short. To control oozing a stout ligature is placed round the tube, ovarian

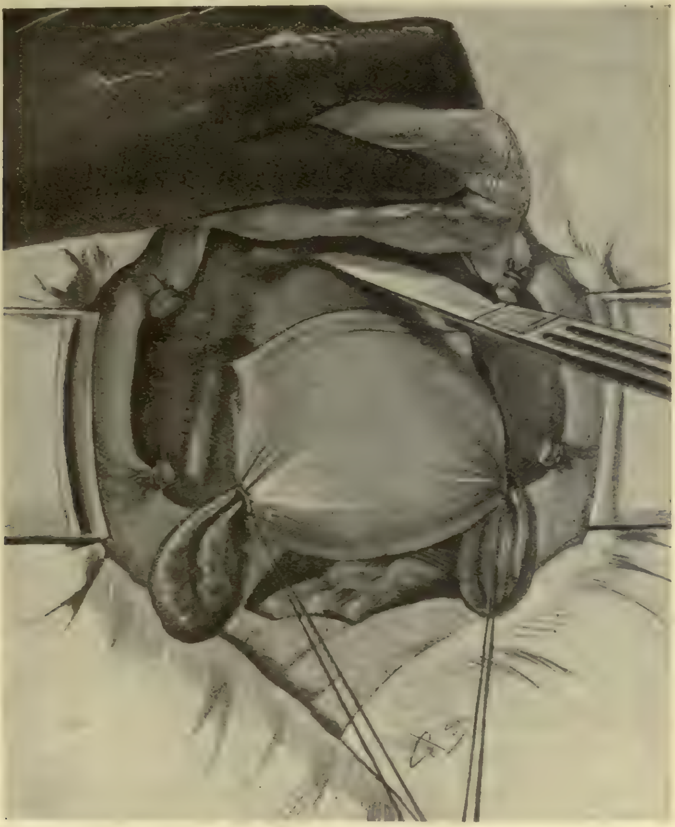

FIG. 176.—Wertheim's hysterectomy.

The broad and round ligaments have been divided and ligatured; the bladder is pushed off the front of the cervix by means of a swab, assisted by light touches of the scalpel.

ligament, and broad ligament close to the cornu ; the ends are left long, to be used as a tractor (Fig. 176). The uterus is drawn over to the left side and the right ovarian artery and round ligament are secured, and the broad ligament divided in the same way.

Stage 2. The peritoneum is divided across the front of the cervix, just above the bladder reflection in such a way as to connect the lateral incisions, and the bladder with its peritoneal covering is pushed down from the front of the cervix and vagina by means of a swab, helped if necessary by a few light snips with the scissors or touches with the scalpel (Fig. 176). This stage is sometimes associated with rather free venous oozing.

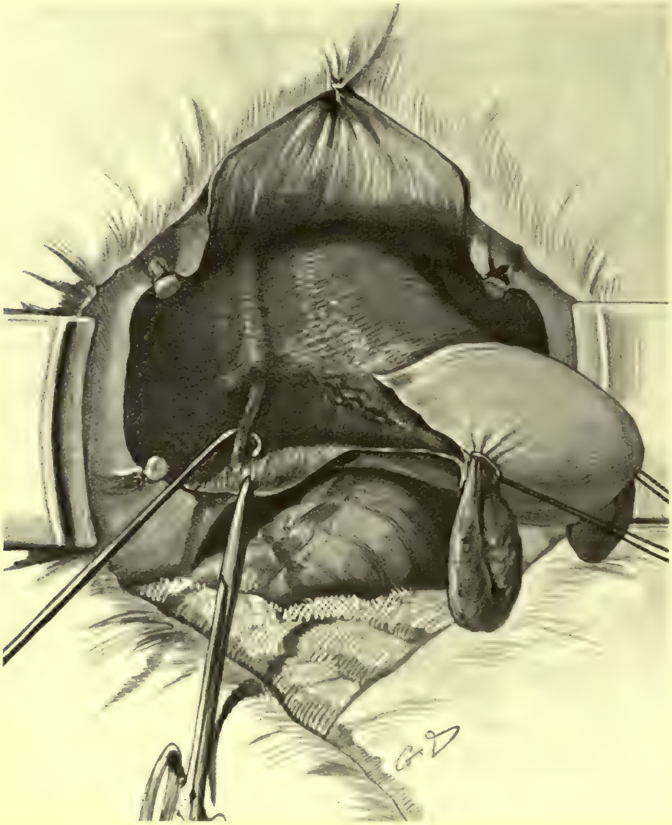

Fig. 177.—Wertheim's hysterectomy.
Identifying the ureter, which is held lightly with an aneurysm-needle.

Stage 3. This stage, which consists of the isolation of the ureters and the tying of the uterine arteries, is often the most difficult part of the operation. The uterus being held well over to the right side, the posterior layer of the left broad ligament is picked up with forceps and with the finger and thumb the ureter can generally be felt lying in close relation to the peritoneum of the posterior layer, near the position of the ovarian ligature. If it is not found at once, the tissues at the base of the broad ligament should be bluntly dissected in a direction parallel with its course. When identified, an aneurysm-needle is passed under it and held by an assistant (Fig. 177), and the ureter is traced forwards to the side of the cervix. Here it passes through the 'ureteric canal,' which is a channel of less dense tissue, under the uterine artery, which crosses it at right angles. The finger is passed through this channel, alongside the ureter, and the band of tissue which forms its roof and contains the uterine artery is raised on the finger (Fig. 178). Each end of the band is caught up with a forceps and the band divided, thus exposing the ureteric canal, with the

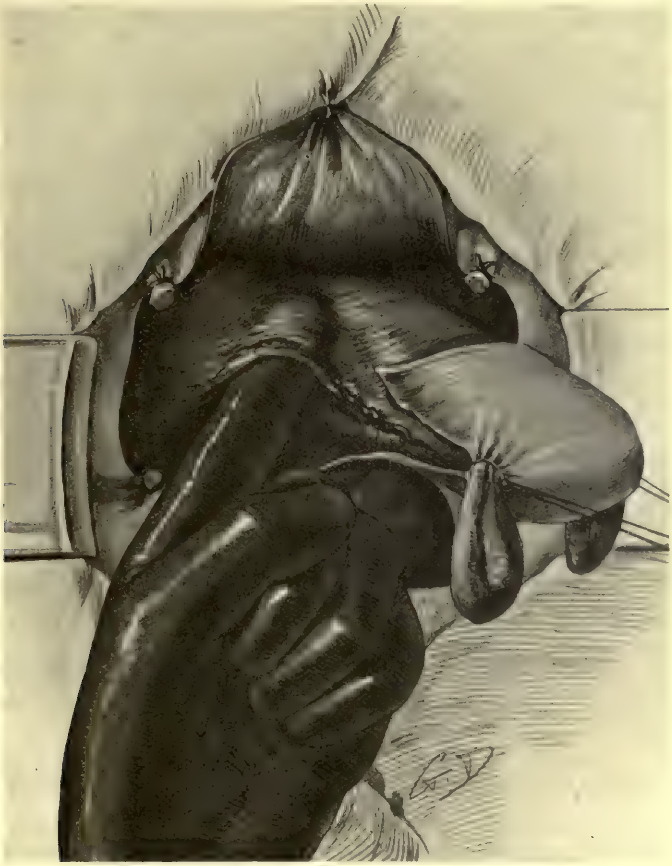

Fig. 178.—Wertheim's hysterectomy.
The finger has been pushed alongside the ureter into the 'ureteric canal,' under the bridge of tissue which contains the uterine artery.

ureter running along its floor. The uterine vessels are secured by tying a ligature round the outer cut-end of the band; the inner end is also tied off, to control bleeding, and the forceps are removed. The ureter is then traced forwards to the base of the bladder. During this part of the operation the ureter is isolated to a certain extent from its surroundings, but great care must be exercised so as to leave its vascular supply undisturbed. Too energetic cleaning of the ureter will lead to necrosis, and subsequent leakage of urine. The process just described is repeated on the right side, the uterus being held over towards the left.

Stage 4. An incision is now carried across the back of the cervix so as to connect the lateral incisions posteriorly. This incision should be as low as possible, in fact, practically in the floor of the pouch of Douglas. The posterior flap is separated from the upper part of the vagina by blunt dissection; the utero-sacral folds, which tend to hold it, are picked up with forceps, divided, and ligatured; and the separation can then be carried farther down, between the rectum and the upper part of the vagina. This process can be effected to a great extent by pushing down the tissues with a swab, as was done anteriorly in separating the bladder.

Stage 5. The loose tissue at the base of the broad ligaments must next be removed. For this purpose a forceps is placed on it at its outer extremity, near the pelvic wall, taking care not to include the ureter, and the tissue is divided with scissors, leaving as much of it as possible connected with the uterus. The uterus and vagina are drawn up, and the bladder and ureters and the rectum pushed well down until the vagina is quite clear below the level of the cervical growth. An assistant withdraws the strip of gauze from the vagina, and the vaginal clamp is applied firmly across the healthy part of the vagina (Fig. 179), the ureters being jealously watched the while. The vagina below the clamp is divided, either by being cut across from side to side with scissors, or by being incised with the knife, in which case the anterior wall is cut across first, and then the posterior and lateral portions. During the cutting across of the vagina, moist sterilized gauze or a swab should be packed round, especially between the rectum and the vagina. With the object of diminishing the risk of infecting the cut edges and raw surfaces with cancer-cells some surgeons use a cautery-knife for the purpose of cutting across the vagina.

Stage 6. As all the important vessels have been ligatured at the time, the field of operation is not obscured by numerous forceps. The cut edges of the vagina should be picked up with forceps, one in front, one behind, and one at each lateral angle. Two mattress-sutures are next passed, as follows: the first traverses the anterior vaginal wall from before backwards, to the left of the middle line, then the posterior vaginal wall, and it is brought forwards again, catching up the tissues on the outer side of the forceps placed at the left angle. On tying this suture the vascular paravaginal tissue is firmly secured. A corresponding suture is placed on the right side. Any oozing points are picked up and tied.

Stage 7. The next step is to explore along the course of the uterine and iliac vessels, in order to remove any lymphatic glands. Sometimes a chain of glands with their intervening tissues can be removed in one piece, right up to the bifurcation of the aorta, and when this is practicable it should be done. Some surgeons advise that this step of the operation should be carried out by the use of the clamp and cautery instead of the knife, the object again being to diminish the risk of implanting cancer-cells.

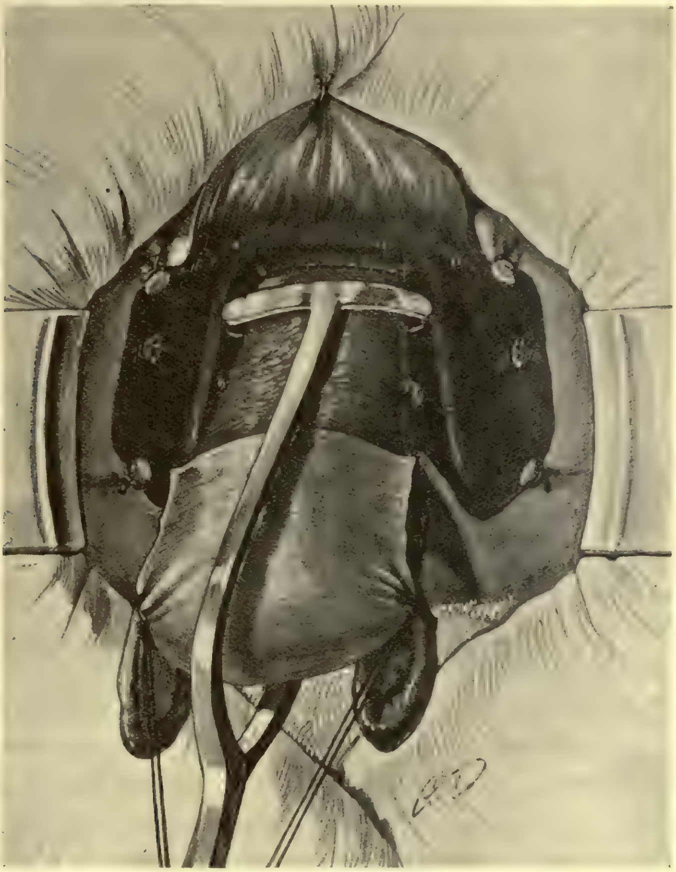

Fig. 179.—Wertheim's hysterectomy.
The vaginal clamp is applied to the healthy part of the vagina, below the uterus and the growth. The vagina is divided in the position shown by dotted lines.

Stage 8. The peritoneal edges are brought together by a continuous suture of fine silk, beginning on the left side as high as the peritoneum has been divided, passing across the floor of the pelvis, and finishing up on the right side. By this means all the raw surfaces are covered over, and the floor of the pelvis has a continuous covering of peritoneum.

The abdominal wall is closed in three layers in the usual way.

A variation of this method is adopted by some operators as follows: The patient is placed in the lithotomy position, a speculum is introduced, and the growth is scraped away as far as possible. The resulting cavity is swabbed out with pure spirit and with iodine, 2 per cent. A circular incision is then carried round the vagina about 2 cm. below the lowest portion of the growth, and a cuff of vaginal wall is dissected up for some distance, whereby the vagina is freed from the urethra and bladder in front and the rectum behind. The cut vaginal edges are sewn across from side to side, so that the cervix is shut in within a closed bag of vaginal wall.

The patient is next placed in the Trendelenberg position, and the operation proceeds as previously described down to Stage 5; then when the bladder and ureters have been separated in front and the rectum behind as far down as the point where the vagina has been divided and sutured, the uterus can be lifted out without the necessity for clamping and subsequent division of the vagina.

Theoretically this method is perfect, but in practice the separation of the vaginal cuff from the rectum and urethra without injury to these structures is not so easy as the description on paper might lead one to suppose.

IV. Operative Risks and Complications

The special risks and complications incidental to the operation of hysterectomy are chiefly injuries to the neighbouring structures, namely, bowel, bladder, and ureters.

Injury to the Bowel.—This accident hardly ever occurs except in the process of separating dense bowel-adhesions, and even then the exercise of great care will usually save any more serious injury than some stripping of the peritoneal coat; but sometimes an actual hole in the bowel is unavoidable, as for example, when a coil of bowel is firmly adherent to a pus-tube which has caused an ulceration through the coats of the bowel.

When the peritoneal coat is torn it should be sutured with a continuous suture or a few interrupted sutures of fine silk; the line of suture should, as far as possible, be transverse, in order to avoid any undue narrowing of the lumen of the gut. This remark applies especially to the suturing of small intestine.

When the muscular coat is also involved, it should be dealt with in the same way.

When the cavity of the bowel is opened, and the rent is clean and not too ragged, it should be sewn up in two layers, the first approximating the cut edges of the mucous membrane, and the second embracing the muscular and peritoneal coats. If the tear is extensive and the bowel-wall in its immediate neighbourhood much damaged, it is better to resect a portion of the bowel when this is possible, and do an end-to-end anastomosis.[1] Some of the most serious cases are those in which the lower part of the sigmoid or the upper part of the rectum is badly torn, for suturing is then a difficult matter. If the operator is in doubt about his union, it may be advisable to do a temporary colostomy, the colostomy-opening being closed later on, when the danger of leakage is past.

Injury to the Bladder.—The bladder is in danger at various stages of the operation. Thus in some cases of fibroids growing in the anterior wall of the uterus, the bladder may be pushed right up into the abdomen, and there is a risk of cutting into it when making the abdominal incision. The practised operator will recognize the bladder when it presents in the incision, and will avoid it by opening the peritoneal cavity higher up.

In the later stages the bladder may be injured in the process of amputating the cervix, and the danger of this accident is chiefly present in cases in which the relations of the parts have been distorted by the presence of cervix or broad-ligament fibroids.

In the course of hysterectomy for carcinoma of the cervix, the bladder may be in great danger when the growth has invaded its base ; indeed, in some cases it is impossible to separate the growth from the bladder without opening the latter.

A partial injury of the bladder, involving only the peritoneal or the muscular coat, should be repaired by means of a continuous suture of fine silk. When the bladder is actually opened, the mucous membrane should be brought together by means of a suture of fine catgut ; silk has been used and recommended for this purpose, but it has the serious drawback that it may act like a foreign body in the bladder and become the nucleus of a stone. I have known this sequel to occur in two cases. When the mucous membrane has been brought together, the muscular coat (or in certain positions the muscular and peritoneal coats) should be closed with a separate suture of fine silk.

Afterwards a self-retaining catheter is left in the bladder, or the patient is catheterized every two hours. The latter course is the better, because a catheter left in may cause injurious pressure on the site of the injury and lead to leakage.

It sometimes happens that the bladder-wall is not found to be invaded by the growth until the operation is so far advanced that it must be carried through; and unless the whole operation is to be rendered abortive this growth must be removed. For this purpose a portion of the bladder-wall must be excised, the incision being carried wide enough to get quite clear of the disease. If the part of the bladder affected is towards the fundus, or at least well removed from the neighbourhood of the trigone, it is a fairly simple matter, and after the excision of the affected area the hole in the bladder is closed as previously described.

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[1] This procedure is fully described in the Article on Intestinal Complications in Gynaecological Surgery (p. 582).—Editors.

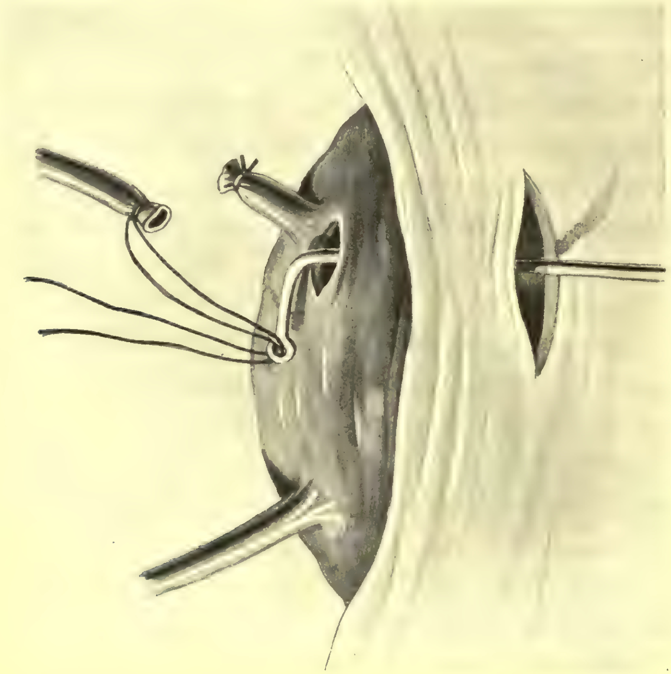

Fig. 180.—Implantation of a cut ureter into the bladder.

The incisions in the bladder have been made; the aneurysm-needle has been passed in through the large incision and out again through the small one, and the ligature on the upper cut end of the ureter has been threaded into the needle.

When the base of the bladder is involved, it may be necessary to remove the insertion of one of the ureters with the bladder-wall; and in that case it will be necessary, not only to close the hole in the bladder, but also to implant the ureter into the bladder in a fresh situation. The method of doing this will be described in the next paragraph.

Injury to the Ureter.—In the case of hysterectomy for fibroids, the ureter is specially liable to be injured when it is displaced from its normal position by a broad-ligament fibroid; and when performing a total hysterectomy, the ureter, which runs very close to the cervix, may be damaged unless great care is taken to keep very close to the side of the uterus when cutting down towards the vagina. The accident may be avoided by adopting the method described under total hysterectomy, in which a thin shell of the outer wall of the cervix is left behind while the core of the cervix is removed.

In operating for carcinoma of the cervix, the risk to the ureter is much greater than in the case of fibroids; partly because of the necessity for a wider removal of the cervix and paracervical tissue, and partly because of the liability to an extension of the growth round the ureter. Further, during the isolation of the ureters in the course of Wertheim's operation, the ureter may be cut higher up in its course, or injured when the uterine artery is being divided.

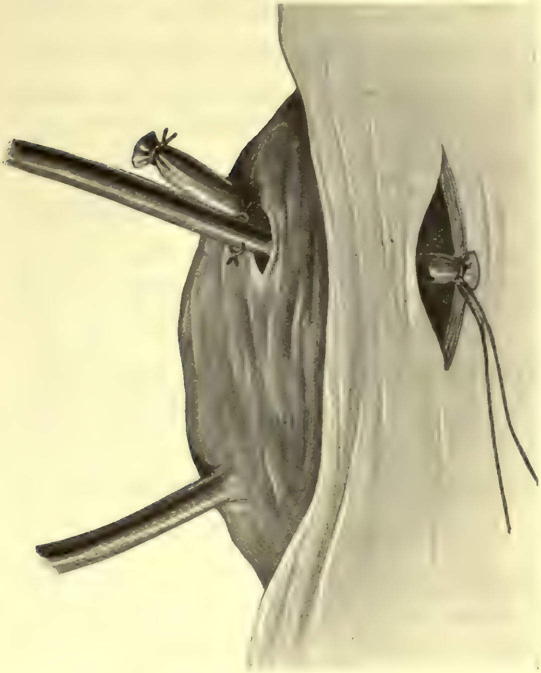

Fig. 181.—Implantation of a cut ureter into the bladder.

The upper cut end of the ureter has been drawn into the bladder.

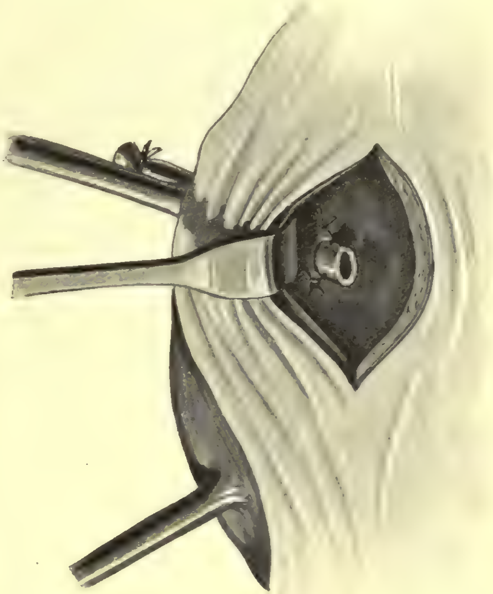

Fig. 182.—Implantation of a cut ureter into the bladder.

The ureter has been fixed in position at the base of the bladder by two fine sutures, and the projecting end of the ureter has been cut off.

Another accident to which the ureter is liable is that it may be stripped too clean, whereby its blood-supply is interfered with, and localized sloughing resulting in leakage may subsequently occur.

The mode of dealing with a damaged ureter will depend on the position of the injury. When this is close to the bladder-wall, the best course is to tie the vesical portion of the ureter and implant the upper portion into the bladder through an incision made for the purpose.

This is done as follows: The cut end of the ureter attached to the bladder is ligatured, to prevent leakage. A ligature is passed round the lower end of the portion of ureter to be implanted, and the ends of the ligature are left long. An incision is made through the fundus of the bladder large enough to admit the index finger. With this in the bladder as a guide, a small opening, only just large enough to admit the ureter, is made in the base of the bladder, just above the ureteric stump. An aneurysm-needle is passed into the bladder through the large upper opening and out again through the small lower opening; the ends of the ligature, which have been left long on the proximal part of the ureter, are threaded into the aneurysm-needle (Fig. 180), and when this is withdrawn, the ligature is seized, and by traction upon it the ureter is drawn into the bladder. It is fixed in position by a couple of sutures of very fine silk, passed through the wall of the bladder, externally, and through the periureteric tissue (Fig. 181), two other fine catgut sutures are passed through the mucosa of the bladder and the wall of the ureter inside the bladder, and the projecting end of the ureter with its temporary ligature is cut off, leaving about 1 cm. of the ureter projecting into the bladder (Fig. 182). The upper opening into the bladder is closed in layers, as previously described (Fig. 183). It is most important, during these manipulations, to avoid stripping too closely the implanted portion of the ureter; for if its blood-supply be interfered with it will certainly necrose and the union will fail.

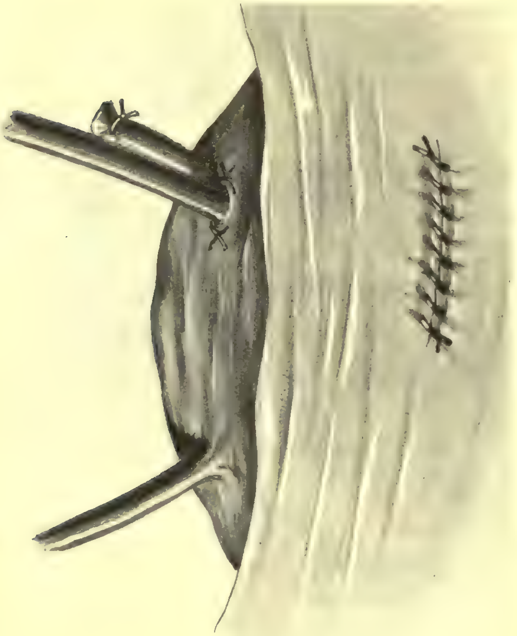

Fig. 183.—Implantation of a cut ureter into the bladder.

The ureter has been fixed to the outer aspect of the base of the bladder with fine sutures; and the temporary incision in the fundus of the bladder has been closed.

When the ureter is injured so high up that it is not possible to bring down the upper cut end and implant it in the bladder, two courses are open. The first is to effect an anastomosis (known as uretero-ureteral anastomosis) between the cut ends. The best way to do this is to split the upper end of the distal portion a little way to enlarge its opening; a fine suture is passed through the lower end of the proximal portion, but not tied; and the needle carrying this suture is passed a little way down the lumen of the distal portion of the ureter and brought out through its wall (Fig. 184, A); by traction on this suture the proximal end is drawn down into the distal portion. The traction ligature is removed, and a couple of fine silk sutures fix the two portions of ureter together to hold them in place (Fig. 184, B). This procedure is at best a difficult one, and even if the junction holds, it is liable to result in stenosis or obstruction.

The second course is to ascertain whether the kidney on the other side is a sound one; and if it is, the proximal end of the cut ureter may be simply ligatured. This is followed by atrophy of the corresponding kidney.

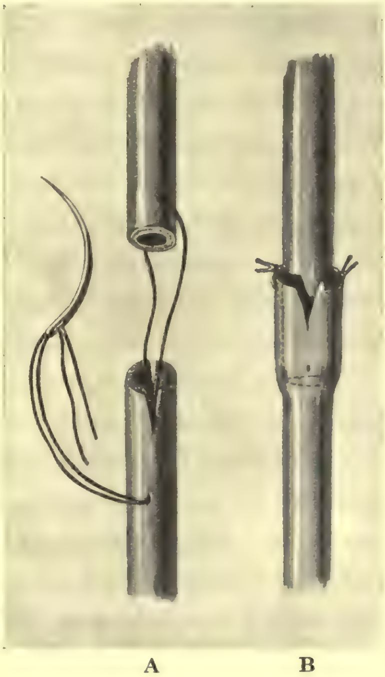

FIG. 184.—Uretero-ureteral anastomosis.

A, The lower end of the ureter has been split; a traction ligature has been passed through the upper end and the ends passed down the lumen of the lower end and brought out through its wall.

B, The upper cut end has been drawn into the lower; the ligature has been removed, and the two portions of ureter fixed together with fine sutures.

V. POST-OPERATIVE COMPLICATIONS AND SEQUELAE

These are dealt with fully in another article,[1] and it will therefore be sufficient here to enumerate briefly the more important complications and the ways of dealing with them.

Shock.—This is now known to occur much more rarely than was formerly supposed; in a large proportion of cases thought to be suffering from shock, the real trouble was internal haemorrhage, or a rapidly-developing sepsis. After hysterectomy for fibroids, shock hardly ever occurs when the operation has been done reasonably quickly. A rapid operator will do a straightforward hysterectomy in twenty to twenty-five minutes, and even a slow one should not take more than an hour. The kind of hysterectomy that is most likely to be followed by shock is

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[1] The After-Treatment of Gynaecological Operation (p. 705).

Wertheim's operation for carcinoma of the cervix, the duration of which may vary from an hour in the hands of a quick operator to three hours in the hands of a slow one.

The treatment of shock is to keep the patient absolutely quiet and warm, and to administer, by the rectum, saline solution given very slowly; this may be supplemented by a small nutrient enema of beef-tea or peptonized milk with brandy.

Vomiting.—Apart from the vomiting directly due to the anaesthetic, which usually comes on shortly after the operation, the most frequent cause of this complication is irritation of the stomach by mucus which has become impregnated with ether and swallowed; in other cases considerable quantities of bile may be brought up. The best treatment is to place the patient in a semi-recumbent posture, and administer a tumblerful of hot water in which a teaspoonful of bicarbonate of soda has been dissolved; this will probably be brought up, washing out the stomach in the process, and a small dose of the bicarbonate of soda in a little water will then usually check the disturbance. Sometimes a single drop of tincture of iodine in a wineglass of water acts like a charm.

When vomiting is persistent it is usually due to incipient sepsis, flatulent distension, or commencing obstruction, and the causal condition must be treated.

Abdominal Distension.—After nearly every abdominal operation a certain degree of paresis of the bowel occurs, leading to distension. The administration of morphia accentuates the tendency, and for this reason this drug should never be given as a matter of routine. The tendency is diminished by propping the patient up in a sitting posture, and by altering her position from time to time. When distension is troublesome a long rectal tube should be passed, or a turpentine enema administered; and the bowels should be opened early. In obstinate cases pituitary extract should be given hypodermically, alternately with hypodermic injections of ergotinine citrate or eserine; and a little peppermint may be given by the mouth. A serious amount of distension may be due to septic peritonitis or intestinal obstruction.

Septic Peritonitis.—This was formerly the most frequent cause of death after hysterectomy; now it is very seldom seen, and the cases in which it occurs are almost limited to those in which some septic condition was already present at the time of the operation, for example pus-tubes, and those in which the field of operation is soiled at the time by injury to the bowel, bladder, or ureters, or by the giving way of the cancerous uterus in the course of removal. In all these cases the risk of sepsis is greatly diminished by efficient drainage. When sepsis is feared, or has declared itself, the patient should be placed in the sitting position known as Fowler's; saline irrigation of the rectum should be carried out at intervals, and if the abdominal cavity has not been drained at the time of operation, the wound should be opened sufficiently to allow of the introduction of a drainage-tube passing down to the floor of the pelvis. If pus can be obtained, vaccines may be given, but unless they are autogenous they are not of great value. Lastly, a vigorous effort should be made to secure an early action of the bowels; one of the best methods is to give repeated small doses ($\frac{1}{6}$ to $\frac{1}{2}$ grain) of calomel alternately with one-drachm doses of sulphate of soda or magnesia, one or other being given every hour until a result is obtained.

Intestinal Obstruction.—This is a rare accident. It must not be confounded with the passive distension of the bowel due to paresis. When symptoms of definite obstruction are present, and especially if faecal vomiting threatens, there is no alternative but to reopen the abdomen and free any adhesion or band that may be responsible for the obstruction. The prognosis in these cases is very bad.

Secondary Haemorrhage.—This accident formerly shared, with septic peritonitis, the unenviable distinction of being responsible for a large number of deaths after hysterectomy. The perfection of technique, in the direction of the deliberate separate ligature of the uterine and ovarian arteries, has almost completely eliminated the risk of secondary haemorrhage, but nevertheless it may occur from the slipping of a ligature. The signs of internal haemorrhage are usually quite clear; the pallor, restlessness, air-hunger, and rapid thready pulse present a striking picture which calls imperatively for the reopening of the abdomen at the earliest possible moment.

Bursting of the Abdominal Wound.—This is due to faulty sewing up. In a clean case, when the abdominal wall has been closed in three layers, the accident should be impossible. When through-and-through sutures are used in a case where there seems to be a likelihood of infection, the accident should not occur if the sutures are of strong enough material and are placed sufficiently close together. I have known of three cases in which the wound burst open after being closed with catgut; and one case in which the patient could not empty the bladder and was told to strain till she managed it—she strained till she burst open the wound. The treatment is of course to sew up again at once.

Bronchitis and Pneumonia.—These conditions are most likely to supervene when ether is administered to a patient suffering from chronic bronchitis, and when the patient is conveyed from the warm operating theatre to another room along cold and draughty passages. They can be avoided by the exercise of proper care. If they occur they must be treated by appropriate means.

Heart-Failure.—It is seldom that a patient cannot stand an operation even when she has valvular heart-disease. The cases in which there is most cause for anxiety are those in which the patient has lost considerable quantities of blood before the operation, and the heart's action is weak and the beat intermittent;

and with these patients the time of danger is not so much in the early days, as when they are beginning to get up. Hence great care must be exercised at this time. Nevertheless cases occur of primary cardiac failure soon after a severe operation, and then it is generally found on *post-mortem* examination that the condition is that known as 'fatty heart.'

Pulmonary Embolism.—Like heart-failure, this is most apt to occur in patients weakened by long draining of blood, and for this reason it is more liable to come on after hysterectomy for fibroids, than after most other abdominal operations. But no class of abdominal operation is entirely exempt from the risk of it. It is an occurrence of a peculiarly tragic character, because it comes on without warning, generally about the tenth day, in cases where the patient has appeared to be making very good progress; often the patient has been talking and laughing happily just before the seizure. When the embolus is large and a large portion of lung is suddenly thrown out of action, death may be almost instantaneous; in other cases it may come on within twenty to thirty minutes. There is then sudden and great pain in the chest, cyanosis, and a violent struggle for breath. The only possible treatment is to give oxygen and perform artificial respiration.

Thrombosis of the Femoral Vein.—This accident is most liable to come on about ten to twelve days after the operation, and it is a remarkable fact that the left leg is affected with much greater frequency than the right; occasionally both legs are affected, the left one starting first, and the right leg about a week later. The cause of the condition is very obscure; several theories have been advanced to explain it, but not one is quite satisfactory. There appears to be little doubt, however, that the thrombosis has an infective origin, and this view receives support from the fact that a slight rise of temperature nearly always precedes the swelling of the leg.

This is not usually a dangerous complication, the only thing to fear being detachment of a fragment of clot leading to pulmonary embolism. As long as the patient is kept very quiet, there is little risk, consequently the treatment consists chiefly of attention to this point. The leg is kept supported on a pillow, and it may be painted with glycerine and belladonna, and wrapped round with cotton wool, kept in place by a long piece of calico, broad enough to be folded over the leg. An ordinary roller bandage should not be used, as it involves too much handling and movement of the leg.

Parotitis.—This complication was formerly more common than it is now. As a rule the parotid gland of one side only is affected, but sometimes both glands suffer, together or consecutively. It is now generally ascribed to oral sepsis, and indeed in some cases the relation between a septic condition of the mouth and parotitis has been clearly traced. The diminished frequency of parotitis may be attributed to two factors : the first is the greater attention paid to hygiene of the mouth, both before and after operation, the second is the different practice that obtains in the matter of allowing the patient plenty of fluid to drink from the first. Formerly no fluid was allowed for twenty-four hours or more, and the result was that the mouth got parched, coated, and foul. The treatment, as will be gathered from these remarks, is mainly prophylactic, but if parotitis supervenes, the gland should be painted with belladonna and glycerine with a pad of wool, or fomentations may be applied.

Urinary Complications.—Whereas most of the complications above described may occur after any abdominal operation, there are certain urinary troubles that are more particularly incidental to hysterectomy.

Retention of Urine.—A functional inability to pass urine naturally sometimes occurs without obvious organic cause, and it may be necessary to pass the catheter for a week or even longer. Nothing is to be gained by making a patient strain to empty the bladder ; on the contrary, definite harm may result, such as the breaking open of the wound.

Suppression of Urine.—With kidney-disease an acute suppression of urine may occur, with a rapidly fatal uraemia. But it is also possible, though happily extremely rare, for suppression to be due to the accident of tying both the ureters inadvertently. In the hands of a practised operator this should, of course, be impossible. If it should occur, the result would almost necessarily be fatal, since the patient's life could only be saved by prompt reopening of the abdomen and restoration of the ureteral communications—an extremely difficult matter.

Leakage of a Ureter.—If a ureter has been cut or damaged in the course of a hysterectomy, leakage may occur into the cellular tissue under the broad ligament ; or through the vaginal vault, if the damaged part of the duct is near the base of the bladder. These accidents are more liable to occur during Wertheim's operation than with other methods of hysterectomy, but it is also possible for the ureter to be damaged when dealing with a broad-ligament fibroid, where the ureter is apt to be displaced. When there are signs of leakage a cystoscopic examination should be made to determine with certainty which ureter is involved, and having decided this point, the operator has a choice of two methods of dealing with it. The first is to reopen and endeavour to unite the cut ends of the ureter or implant the upper end in the bladder ; the second is to remove the kidney on the affected side. The latter is the better plan when the operator can assure himself that the other kidney is healthy.[1]

Vesico-Vaginal Fistula.—This may occur as the result of an injury to the bladder-wall that has been overlooked at the time of the operation ; and also when a wound of the bladder-wall that has been sewn up fails to unite. A vesico-vagina fistula can only result from an injury to the bladder on the vaginal aspect of this organ, and therefore it is found only after a vaginal hysterectomy or after an abdominal total hysterectomy, and especially after a Wertheim's operation. The position of the fistula is generally at the summit of the vaginal vault, which makes it very difficult to repair by the ordinary procedures.[1] In one case brought to me by a surgeon who had not been able to close the fistula by the vaginal route, I opened the abdomen, and separated the bladder from the vagina, and sewed up each separately, with a satisfactory result.

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[1] See Catheterization of the Ureters (p. 171).—Editors.

VI. Operative Mortality

In order to obtain exact data of the present status of the mortality of hysterectomy operations, I wrote to the Registrars of the London Hospitals, asking for the results for the five years January 1909 to December 1913. I wish here to express my indebtedness to those who so kindly complied with my request.

Vaginal Hysterectomy need hardly be considered, as it is so seldom done at the present day. In all the hospitals quoted below taken together, there were barely a score of vaginal hysterectomies in the five years under consideration. The largest number was at St. Bartholomew's, but even there, out of a total of 218 hysterectomies only 18 were vaginal, viz. 1 for fibroids, 12 for carcinoma of the cervix, and 5 for carcinoma of the body. Too much stress cannot, of course, be laid on small figures, but as far as they go the results at this hospital are definitely in favour of the abdominal route, which showed 200 cases with 13 deaths, a mortality of 6·5 per cent; whilst the vaginal route had 18 cases with 3 deaths, a mortality of 16·6 per cent.

Abdominal Hysterectomy for Fibroids.—The following is a list of the results at different hospitals, the name in brackets being the authority for the figures:

	Cases.	Deaths.	Mortality.
			Per cent.
Chelsea Hospital for Women (A. E. Giles)	555	7	1·26
The Hospital for Women, Soho (Trevor Davies)	348	3	0·86
Samaritan Hospital for Women (A. W. Bourne)	325	15	4·61
The New Hospital for Women (House Surgeon)	195	2	1·02
Charing Cross Hospital (Gordon Ley)	47	2	4·25
Guy's Hospital (A. J. M'Nair)	190	3	1·58
King's College Hospital (Eardley Holland)	65	1	1·54
London Hospital (S. Gordon Luker)	318	5	1·57
Middlesex Hospital (W. Gilliatt)	343	8	2·33
St. Bartholomew's Hospital (Malcolm Donaldson)	158	8	5·06
University College Hospital (G. G. Alderson)	81	1	1·23
Prince of Wales's Hospital, Tottenham (A. E. Giles)	116	3	2·58
Total	2741	58	2·11

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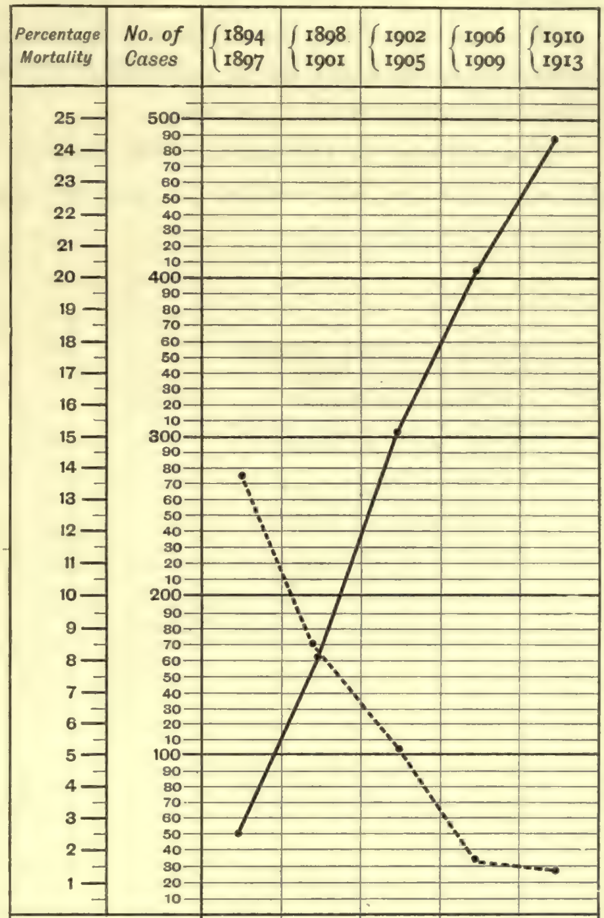
[1] See Article on Fistulae in the Female Genital Tract (p. 639).—Editors.

My own figures for the last 10 years (June 1, 1906 to May 31, 1916) show 572 hysterectomies with 8 deaths, a mortality of 1·38 per cent; and for the last five years (June 1, 1911 to May 31, 1916) 350 cases with 3 deaths, a mortality of 0·85 per cent.



	1894–1897	1898–1901	1902–1905	1906–1909	1910–1913
No. of Cases (continuous line)	51	163	305	406	488
Deaths	7	14	16	7	7
Percentage Mortality (interrupted line)	13·7	8·5	5·2	1·7	1·4

Fig. 185.—A chart showing the number of hysterectomies for fibroids in successive four-yearly periods, with the corresponding mortality, at the Chelsea Hospital for Women, London.

The results of hysterectomy for fibrosis are much the same. I have not data on this subject from the hospitals above mentioned, but my own figures for 10 years show exactly 100 cases with 1 death, a mortality of 1 per cent.

Few things in surgery are more remarkable than the diminution in the mortality of hysterectomy for fibroids since the introduction of the intraperitoneal method 25 years ago. At that time the mortality stood at 20 to 30 per cent, and within 5 years it dropped to about a half. With the decreased mortality the scope of the operation rapidly increased. This progress is strikingly shown in the accompanying chart (Fig. 185), which shows the number of hysterectomies for fibroids and fibrosis at the Chelsea Hospital for Women during the last 20 years. This period has been chosen because in 1894 a Registrar was appointed, and since then a tabulated list of the operations performed has been published regularly in the Annual Reports of the Hospital. It will be seen, on referring to the chart, that in the first four years there were 51 hysterectomies with a mortality of 13·7 per cent. In each successive period of four years the number of cases increased, while the mortality diminished, until in the last four years there were 488 cases with a mortality of 1·4 per cent.

We may conclude from the above data that in the hands of experienced operators the mortality of hysterectomy for fibroids at the present time is not appreciably higher than 2 per cent.

Hysterectomy for Carcinoma of the Body of the Uterus.—The figures relating to this operation for five years at the hospitals already mentioned are as follows, the authorities being as before :

	Cases.	Deaths.
Chelsea Hospital for Women	43	1
The Hospital for Women, Soho	6	1
The Samaritan Hospital	44	0
The New Hospital for Women	9	0
Charing Cross Hospital	4	1
Guy's Hospital	8	0
King's College Hospital	0	0
London Hospital	31	2
Middlesex Hospital	7	0
St. Bartholomew's Hospital	6	0
University College Hospital	12	2
Prince of Wales's Hospital, Tottenham	16	0
Total	186	7 Mortality, 3·76 per cent.

In my own practice during the same period there were 25 cases with no deaths.

In view of the gravity of these cases a mortality of 4 per cent may be regarded as reasonably low, and, as will be seen, it compares very favourably with the results of removing the uterus for cervical carcinoma.

Hysterectomy for Carcinoma of the Cervix.—In attacking this condition by the abdominal route the operator may do a simple panhysterectomy, or he may adopt Wertheim's procedure. In the returns obtained from different hospitals, some do not specify which operation was done, whilst others show separately the number of cases of each kind ; I have therefore given the particulars in the form here following :

	Wertheim's Operation.			Panhysterectomy.			Total.		
	Cases.	Deaths.	Mortality.	Cases.	Deaths.	Mortality.	Cases.	Deaths.	Mortality.
			Per cent.			Per cent.			Per cent.
Chelsea Hospital for Women .	60	13	21·6	..	..	..	60	13	21·6
The Hospital for Women, Soho	25	3	12·0	43	2	4·6	68	5	7·3
The Samaritan Hospital . .	91	7	7·7	14	..	..	105	7	6·6
The New Hospital for Women	..	..	..	..	..	..	79	2	2·53
Charing Cross Hospital . .	10	3	30·0	5	..	..	15	3	20·0
Guy's Hospital	..	..	..	..	..	..	52	7	13·4
King's College Hospital . .	10	1	10·0	..	..	..	10	1	10·0
London Hospital . . .	..	..	..	..	..	..	107	8	7·5
Middlesex Hospital	..	..	..	..	..	..	86	27	31·4
St. Bartholomew's Hospital .	12	2	16·6	24	3	12·5	36	5	13·9
University College Hospital .	40	5	12·5	3	..	..	43	5	11·6
Prince of Wales's Hospital, Tottenham	11	..	..	1	..	..	12	..	..
Total . . .	259	34	13·1	90	5	5·5	673	83	12·3

In my own practice, during the same time, there were 17 cases of Wertheim's operation, and 2 cases of panhysterectomy, with no deaths in either group.

It will be observed that the mortality of panhysterectomy is appreciably lower than that of Wertheim's operation ; no doubt this may be explained, in some measure, by the fact that panhysterectomy is mostly restricted to comparatively early cases, whilst Wertheim's operation is often done in advanced cases. Berkeley and Bonney collected statistics that showed that among cases of Wertheim's operation the primary mortality was much higher with advanced than with early cases. They give the following figures:[1]

In 186 advanced cases the mortality was 23·1 per cent.
In 19 moderate ,, ,, ,, 5·2 ,,
In 33 early ,, ,, ,, 6·3 ,,

These authors further state that at that time (1910) they had collected 313 cases of Wertheim's operation in the British Isles, with a mortality of 18·5 per cent. The above list of 259 cases in London hospitals, with a mortality of 13·1 per cent, would appear to show some improvement ; but the cases at the Middlesex Hospital, where the nature of the operation was not stated, were probably nearly all Wertheim's operation, and if we include them in our list of Wertheim's, we get 345 cases with 61 deaths, or 17·6 per cent ; so the improvement is more apparent than real.

When more time has elapsed in which to judge of the remote results of Wertheim's operation, the question of the legitimate scope of this procedure will have to be reconsidered very carefully. It is probable that the consensus of opinion will be that the operation has a valuable place in the treatment of early and moderate cases, but that it is not advisable with advanced cases, because it will be found that the expectation of life in cases that recover from the operation is very little better than in cases that have not been operated upon, and therefore the high primary mortality is not justified.

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[1] *A Text-Book of Gynaecological Surgery*, Cassell & Co., 1911, p. 364.

VII. LATE RESULTS OF HYSTERECTOMY

1. Hysterectomy for Fibroids.—Some years ago I investigated the after-results of various abdominal operations on the pelvic organs,[1] and among the cases traced were 186 cases of hysterectomy for fibroids and fibrosis. The questions considered were the following :

1. How is the general health affected ?
2. What is the fate of the cervical stump in cases of supravaginal (subtotal) hysterectomy ?
3. Does menstruation continue after supravaginal hysterectomy ?
4. The apparent menopause.
5. What is the effect of hysterectomy on the sex-instincts ?

The patients concerned in this enquiry had been operated upon at least a year before, and with many of them a long time had intervened, up to sixteen years. The conclusions arrived at were these :

1. The effect on the general health of hysterectomy for fibroids is very satisfactory, inasmuch as 70 per cent of the patients were in very good health after the operation, and as many as 96 per cent were better than before the operation.

2. The fate of the cervical stump after supravaginal hysterectomy need cause no apprehension : in 181 cases there was not one that showed any sign of malignancy, and in 98·3 per cent there was no trouble of any kind. In cases of fibrosis, however, it is important either to do a panhysterectomy, or at least to make sure that the whole of the body of the uterus is removed, as a small portion of the body of the uterus may keep up haemorrhage.

3. After hysterectomy menstruation usually ceases ; but if a small portion of the body of the uterus be left, as may happen in a high supravaginal amputation, menstruation may continue regularly for a longer or a shorter period, with no other apparent difference than a diminution in quantity. The continuation of menstruation has no drawbacks, unless it should be associated with profuse losses, and this only happened in one case.

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[1] Arthur E. Giles, *A Study of the After Results of Abdominal Operations on the Pelvic Organs based on a Series of 1000 consecutive Cases.* London, Baillière, Tindall & Cox, 1910.

4. In the case of a normal woman the cessation of menstruation is a proper indication of the climacteric, because there is a correlation between the diminution or cessation of ovarian activity and the cessation of menstruation. But when the uterus is removed, with the preservation of one or both ovaries, during the period of sexual maturity, the cessation of menstruation is not a true menopause, because the ovarian activity continues for some time longer. I have therefore called it the 'apparent' menopause.

In the absence of menstruation, we still have a symptom of some value in determining the time of onset of the true menopause—namely, the incidence of the flushes and the waves of heat which almost invariably accompany the normal change of life.

An analysis of 109 cases of patients whose age at the time of operation was not more than fifty, and where the time that elapsed between the operation and the onset of flushes was known, brought out two points: First, that the true menopause does not usually come on for several years after the removal of the uterus, with conservation of one or both ovaries, in women who have not attained the age of the menopause, and consequently the cessation of menstruation in such cases is properly described as an 'apparent' menopause. Secondly, that the removal of the uterus (alone) often brings about the true menopause a good deal earlier than the usual time.

5. There were 64 cases of married women where data were available. Analysis of these data showed that the sex-instincts are unaltered or increased after hysterectomy in 82 per cent of cases when both ovaries are left, in 77 per cent when one ovary is removed, and in 78 per cent when both ovaries are removed; in other words, there is a slight diminution of sex-instincts in about 20 per cent of cases, whether the ovaries are removed or not. After hysterectomy with preservation of one or both ovaries, the sex-instincts are practically never lost altogether, as such a result occurred in only 1·5 per cent of the cases.

2. Hysterectomy for Carcinoma.—The question of the recurrence of the growth after hysterectomy for carcinoma is such a complex one, that its proper discussion would carry us beyond the limits suitable for the present article; and readers who are interested in this matter are referred to the article on Uterine Carcinoma (Vol. II. p. 415). It will be sufficient to say here that the after-results in carcinoma of the body of the uterus are most satisfactory, as the permanent cures, even after many years, may be put down as 95 per cent.

With carcinoma of the cervix, the proportion of cures varies considerably as reported by different operators. It is generally held that patients who have remained free from recurrence for five years may be regarded as cured; although recurrence has been known to occur after longer periods than this. Berkeley and Bonney[1] cite the following figures: *Cures after Wertheim's operation*: Wertheim 62 per cent; Polosson 60 per cent; Mackenrodt 45 per cent; Bumm 30 per cent. *Cures after vaginal hysterectomy*: Jacobs 1·2 per cent; Gusserow 2·5 per cent; Olshausen 6·6 per cent; Kustner 9·2 per cent; Kaltenbach 9·2 per cent; Leopold 8·2 per cent; Döderlein 9 per cent; Pozzi 9 per cent; Polosson 12 per cent; Spencer 24 per cent; Lewers 16 per cent.

It is evident that the value of the information supplied by these figures is discounted by the fact that they do not differentiate between cases where the disease was early and those where it was already advanced at the time of operation. An exhaustive enquiry into after-results based on this distinction would be of great value, but the subject is beset with difficulties, chief among which is that of defining a standard as to what is an early and what is an advanced case.

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[1] *Op. cit.* pp. 367, 368.

SURGICAL OPERATIONS ON THE GRAVID UTERUS

By Professor J. M. Munro Kerr
(Glasgow)

Under the heading Surgical Operations on the Gravid Uterus, I propose to consider the following: (A) Abdominal Caesarean Section with Conservation of the Uterus. (B) Abdominal Caesarean Section followed by Hysterectomy. (C) Myomectomy. (D) Vaginal Hysterotomy—Vaginal Caesarean Section. (E) Vaginal Hysterectomy.

A. Abdominal Caesarean Section, followed by Conservation of the Uterus

Indications.—At the present time obstetric surgeons are particularly interested in this operation because so many of them feel that its scope should be extended, and that it should be employed more frequently for obstetric complications than has been customary in the past. Some of the leading obstetricians in this and other countries consider that such complications as, for example, eclampsia, placenta praevia, and accidental haemorrhage should be more frequently dealt with by this purely surgical procedure than by the methods which until recently have been generally recommended and employed. Naturally when a question of such importance is under discussion and when equally distinguished obstetricians are expressing opposite views, it is quite impossible for a writer entrusted with such an article as the present to be dogmatic; he can merely indicate his own particular views. I propose therefore to consider briefly the conditions for which the operation may be employed, and to try and indicate under what circumstances Caesarean section should be chosen.

Contracted Pelvis.—Caesarean section is indicated in contracted pelvis when a living child at or about full time cannot be born by the natural passage, or when, the child being dead, the risks of craniotomy are greater than those of Caesarean section.

From my experience of contracted pelvis, I have come to the conclusion that unless the child is very small Caesarean section should be chosen whenever the conjugata vera is under 3¼ inches (8·1 cm.). I do not mean to imply that it is never necessary at 3¼ inches (8·1 cm.), for even above that figure it may occasionally be indicated, nor do I mean that some other operation should not occasionally be substituted for it even at 3 inches (7·5 cm.); all I wish to imply is that when the conjugata vera is below 3¼ inches, one must estimate very carefully indeed the relative size of the head and the pelvis. Any other procedure than Caesarean section should only be employed if the overlapping is slight and a certain degree of fitting of the head into the brim of the pelvis can be secured by pushing the head into the pelvic brim.

The method which I employ for estimating the size of the head and the pelvis was described by me several years ago, and is here illustrated (**Fig. 186**). By using the thumb as there indicated, I find I can estimate with accuracy the relative size of the head and the pelvis, and can predict whether the child can be brought safely through the pelvis or not.

In recent years pubiotomy has been advocated as an alternative to Caesarean section, but personally I do not consider that pubiotomy comes into competition with Caesarean section, although I believe it is indicated and should be employed in certain cases. The suitable cases are those in which the accoucheur has carefully estimated the relative size of the head and the pelvis, has erroneously come to the conclusion that spontaneous delivery will occur, has made one or two attempts with forceps (employing moderate traction), and has failed to deliver. If he employs pubiotomy under such circumstances he will almost without exception secure satisfactory results.

Seldom does induction of labour come into competition with Caesarean section, for very rarely are the results good with induction if the operation is employed when the conjugata vera is under 3¼ inches. Induction of labour to my mind is indicated when from experience of a previous difficult forceps extraction, the operator feels that a slightly smaller child can be easily and safely delivered.

Caesarean section should always be performed if the child is alive, and craniotomy if the child is dead. But there are exceptions to both of these rules: for example, it is frequently inadvisable to perform Caesarean section even although the child is alive; thus in cases where labour is far advanced, especially when many examinations have been made by those who have not very thoroughly cleansed their hands, Caesarean section shows a very high maternal mortality, running up even as high as 25 to 30 per cent; in such cases the majority of accoucheurs consider it better in the interests of the mother and even of the State to perform craniotomy rather than Caesarean section. On the other hand craniotomy should not be undertaken, even although the child is dead, if the conjugata vera measures less than 2¼ inches, for in such cases craniotomy is extremely difficult and dangerous to the mother.

Tumours.—The tumours of the pelvis which most frequently necessitate Caesarean section are fibromyomata, and the operation is always indicated provided the tumour cannot be pushed out of the pelvis; under no circumstance whatever is it justifiable to drag the child past an obstructing fibroid. I shall consider later the treatment of the uterus after Caesarean section. In passing let me remind my readers that fibromyomata, even those impacted in the pelvis, may be dragged up by the growing uterus, and not only the pregnancy continue undisturbed but parturition may take place by the natural passage without any serious risk to the mother.

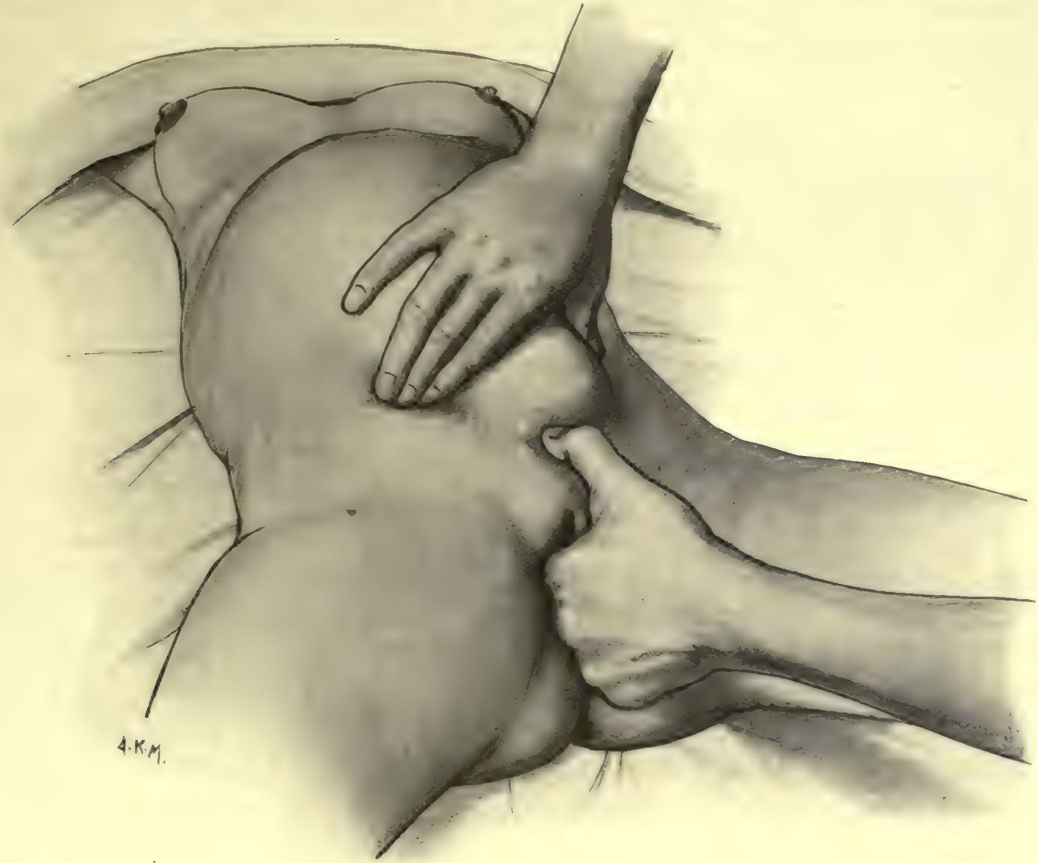

FIG. 186.—Munro Kerr's method for estimating relative size of foetal head and maternal pelvis.

As regards ovarian tumours complicating labour, Caesarean section is rarely necessary. In a few cases where the ovarian tumours are impacted in the pelvis it has been found impossible to remove the tumour without previously emptying the uterus. Undoubtedly the ideal treatment in all ovarian tumours complicating labour is to remove the tumour either by the abdominal or vaginal route, and permit the labour to take place by the natural passage.

Tumours of the bony pelvis or the soft tissues covering the bones are of rare occurrence, but quite recently I encountered a tumour of the soft parts, made up of a large mass of degenerated glands, which obstructed the canal to such an extent that Caesarean section was necessary. The removal of such tumours is rarely advisable. Many of them are malignant, and so removal is profitless ; even those which are simple can only be removed with extreme difficulty and danger to the patients.

Eclampsia.—Within recent years a considerable number of cases have been recorded in which Caesarean section has been employed for this condition. In my department of the Glasgow Maternity Hospital the operation has been performed on four occasions. I am convinced that the treatment is sound in all cases in which the disease does not yield to the ordinary medical remedies usually employed.

The operation naturally competes with *accouchement forcé* either by rapid dilatation of the cervix or by vaginal Caesarean section. I shall have more to say about vaginal Caesarean section later ; I would only state here that I consider the abdominal route is superior to the vaginal in the later weeks of pregnancy.

It is quite possible that in years to come Caesarean section may be employed more frequently for this and other toxaemias of pregnancy. Quite recently Bonney[1] recorded a case in which he performed the operation for threatening eclampsia.

At the present time my own results are one death in four cases. In all these cases the patients were extremely ill, and as far as could be judged were rapidly going down-hill. In two of the cases almost immediately after the uterus was emptied, marked improvement of the condition occurred. Roughly speaking, the mortality is about 30 to 40 per cent ; but the reason why it is so high is because many obstetricians are disinclined to employ it until all other measures have proved futile. High as the mortality is, it is decidedly lower than it was a few years ago, and will be still further reduced when obstetricians recognize that the operation must not be delayed until the woman is almost moribund. Ordinary recognized methods of treatment should certainly be given a trial, but if no improvement follows the uterus should be emptied immediately.

Placenta Praevia.—I am in entire agreement with those modern obstetricians who recommend this operation in carefully selected cases, but I have no sympathy with those who advocate its general employment.

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[1] *Trans. Roy. Soc. Med.* (*Obst. and Gyn. Sect.*), 1914.

The cases suitable for Caesarean section are primiparae at full time with central placenta praevia, and in whom there is a prospect of an extremely prolonged and difficult labour, with the almost certain loss of the child and the great risk that the mother may become infected during the numerous vaginal manipulations which are necessary, if the ordinary methods of treatment are employed.

Impacted Shoulder Presentation.—Very rarely indeed is it advisable to employ Caesarean section in this condition. In most cases when the shoulder has become impacted, the child is dead or much enfeebled, and the mother is infected owing to numerous vaginal examinations and manipulations. The safest procedure in such cases is decapitation, and personally I would only think of performing Caesarean section if I were absolutely certain that every possible precaution against infection had been taken by those in attendance.

Retraction Ring.—In recent years some interesting cases have been recorded where this condition has been associated with very decided dystocia. At present, however, it would be unwise to attempt to define the cases in which Caesarean section is indicated, as the subject is still under discussion.

Rigidity of Soft Parts.—Caesarean section is occasionally indicated in cases where the soft parts are peculiarly rigid, as, for example, in elderly primiparae, and in multiparae when as a result of previous injuries extensive cicatrization has occurred. Personally I have employed this operation on two occasions, and I feel convinced it should be employed more frequently for this condition.

Ventri-fixed Uterus.—There are a few recorded cases where Caesarean section has been necessary for this condition. In the Glasgow Maternity and Women's Hospital we have had four or five cases in the last ten years. This subject is considered in connection with the treatment of retro-displacement of the uterus (Vol. II. p. 625).

Details regarding Operation.—*Preparations.*—This is precisely the same as for any other abdominal operation. If time permits the patient should have her bowels thoroughly evacuated, and in addition if she is the subject of rickets she should be relieved of the bronchial catarrh so commonly present. It is therefore advisable to have all patients in hospital for a day or two before operation. This, however, is not always possible, and so a great number of them have to be operated upon hurriedly and without any elaborate preparation.

I have tried many methods for preparing the field of operation—the abdominal wall—and I am bound to say from my own personal experience that the iodine method so generally employed in surgical practice has given me the best results. The method is fully detailed elsewhere.[1]

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[1] Article on Technique (p. 283).

How far elaborate cleansing of the vagina with ethereal soap and douching is advisable is a matter regarding which I do not care to be dogmatic. I am inclined, however, to favour the careful cleansing of the vagina, although I know at the present time the majority of operators are rather opposed to any vaginal disinfection except in cases where there is the possibility that the passage has been infected.

The operator requires one assistant besides the anaesthetist. With the drums of sterilized gauze at the assistant's elbow and instruments and ligatures at the operator's side, one nurse who keeps a careful record of the number of swabs is all that is necessary. Arrangements must also of course be made to have some capable individual to look after the infant.

The instruments required are few and very simple: two scalpels, two pairs of stitch forceps, two pairs of scissors, a dozen and a half of pressure forceps, six pairs of broad-ligament clamps (in case it is found necessary to remove the uterus), one needle-holder, eight needles (four large and four small), self-retaining retractor (if hysterectomy is contemplated), catgut, silk, and silkworm-gut ligatures.

As regards swabs I employ two varieties: one set of about two dozen of large size with a tape attached at one corner; these are employed for packing off the intestines and surrounding the uterus. The other set, about three dozen, is of smaller size; they are used only for mopping, and never under any circumstance should they be placed inside the abdomen.

Time to operate.—In many cases there is no choice of time, but where the patients come under one's care prior to the onset of labour the question arises, should Caesarean section be performed at the end of pregnancy or should the operator delay until labour has started? Personally I think there is much to be said in favour of operating before labour has commenced, and in multiparae I always do so if possible, and I have never seen any trouble result. On one or two occasions, however, I have noticed that primiparae were considerably disturbed by after pains, and so in operating upon them I prefer to do so shortly after labour has commenced.

When the uterus has to be removed it is a distinct advantage to operate before labour has started for the cervical stump is much smaller.

Operating before labour commences is only suitable in those cases in which there is absolutely no doubt that Caesarean section is necessary. Should there be a reasonable expectation that the labour may be terminated spontaneously or by forceps, the patient must be allowed to continue for some time before a final decision is come to.

There is one disadvantage in operating before the onset of labour, viz. that one may occasionally perform the operation before term, and so deliver a child distinctly premature. This is especially apt to occur in hospital practice, for the women are often so uncertain regarding the onset of pregnancy that it is sometimes impossible to estimate the age of the child.

Personally I consider it a mistake to give ergotine before the commencement of the operation, for if the drug takes effect before the uterus has been emptied a longer uterine incision is necessary for the extraction of the child. Besides I have found that it is more difficult to get exact coaptation of the uterine wound if the uterus is ' contracted ' than if it is simply ' retracted.'

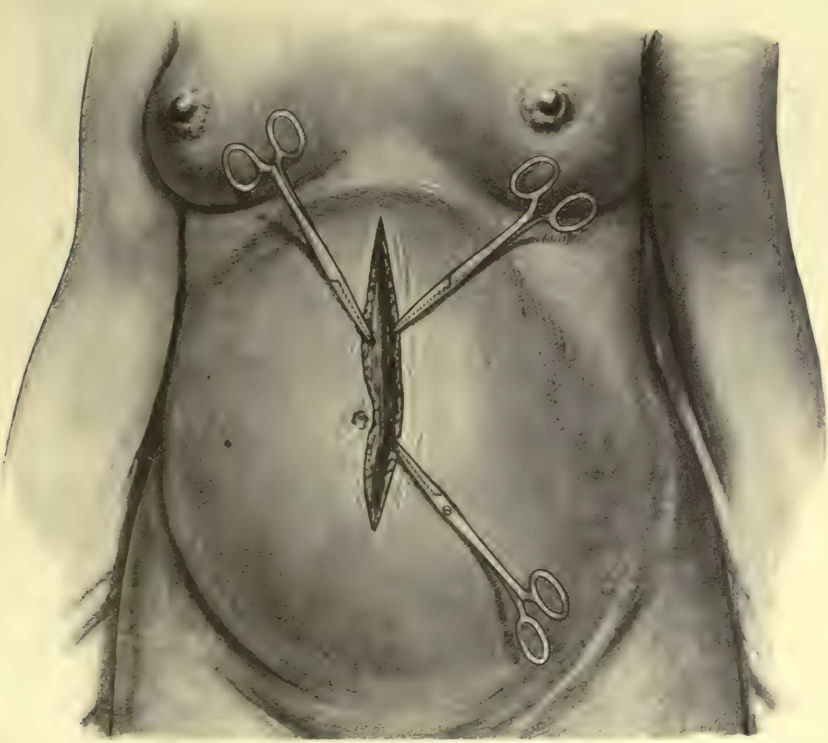

Fig. 187.—Abdominal incision placed two-thirds above and one-third below umbilicus. (*Operative Midwifery,* Munro Kerr.)

Abdominal Incision.—The abdominal incision most usually employed is a median longitudinal one of from 7 to 8 inches with two-thirds of its length above the umbilicus and one-third below (Fig. 187). The abdominal incision employed for extraperitoneal Caesarean section is considered later when the method of operating is under discussion.

As the enlarged uterus lies directly against the abdominal wall there is little risk of doing injury to the bowel in making the abdominal incision, still the usual care must be taken in dividing the abdominal parietes. Bleeding points should be secured with pressure forceps. If these are left on for a moment or two all bleeding is arrested. It is seldom necessary to tie any bleeding points. Having opened the abdomen the intestines should be carefully packed off with gauze swabs.

Uterine Incision.—Before making an incision into the uterus the operator must determine whether he will open the uterus *in situ* or turn it out of the abdomen prior to making his incision into it. Both proceedings have their advocates. On the one hand, by turning out the uterus and surrounding it with gauze, blood and liquor amnii are prevented from soiling the peritoneal cavity (Fig. 188); on the other hand, if the uterus is turned out a large uterine surface is exposed and a longer abdominal incision is required. My own practice is to open the uterus *in situ* in cases where the labour is not far advanced, where there has been no chance of vaginal infection, and where the membranes are still intact, and to turn out the uterus prior to opening it where the membranes are already ruptured, and in all cases where I fear infection of the vagina may have occurred.

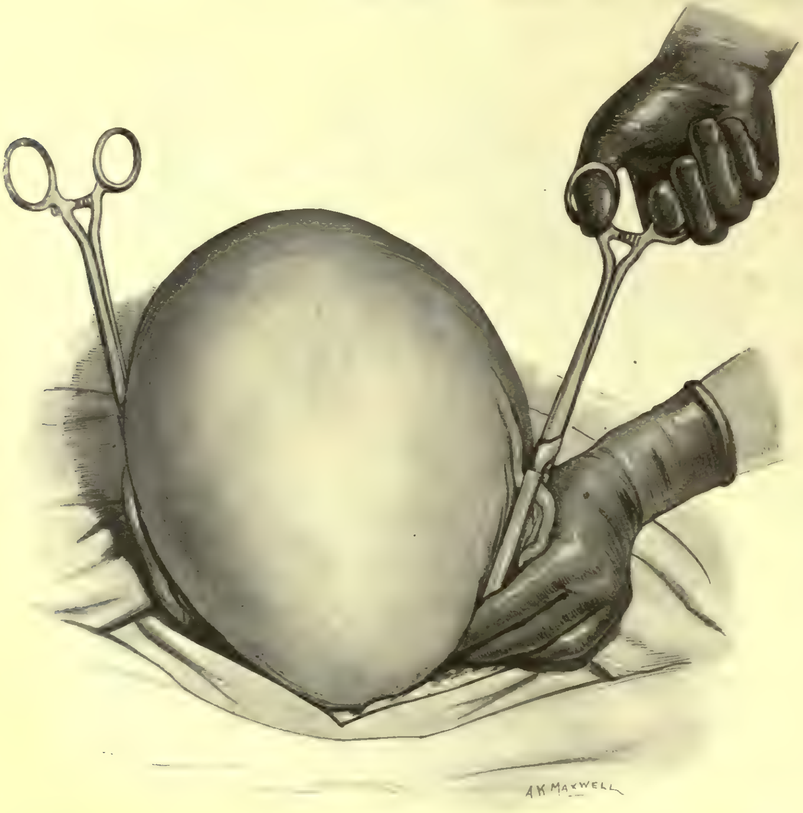

Fig. 188.—Clamps applied temporarily to arrest bleeding. (*Operative Midwifery*, Munro Kerr.)

The uterine incision most usually employed is a median longitudinal one; it should be 6 inches in length. Many other incisions have been suggested and tried, such as a transverse incision over the fundus, but at the present time the only alternative one employed is an incision through the lower uterine segment, and it will be more particularly considered in connection with 'extraperitoneal' section.

With the uterus outside the abdomen it is a simple matter to make the incision exactly median, but when the uterus is *in situ* it will often be found necessary to twist the uterus round towards the right or left (usually to the left, because the uterus is dextroverted in most cases) in order to bring the middle of the anterior wall immediately below the abdominal incision.

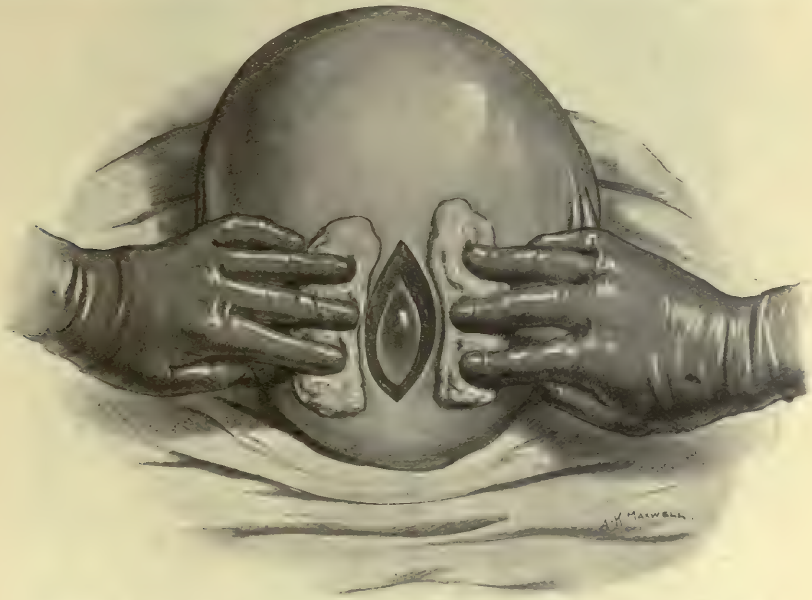

FIG. 189.—Arresting bleeding from uterine wound by pressure at the sides.

In cutting through the uterine wall the bleeding varies; it is very considerable when the placenta is situated under the incision, and this I have found to occur in 35 to 40 per cent of my cases. In order to avoid encountering the placenta it was suggested by Olshausen and others that the uterine incision should be made in a part of the uterine wall away from the placental site. But it is no easy matter to determine the exact situation of the placenta, and so the majority of operators disregard the placenta and make the incision already described.

In order to control the bleeding of the uterine incision several devices have been tried. The most effective is to employ a tourniquet round the lower part of the uterus, but that is supposed to favour uterine inertia and post-partum haemorrhage.

Another device is temporarily to clamp the broad ligaments (Fig. 188), but these devices are unnecessary, as sufficient control can be secured by the operator and his assistant pressing on the uterus with a swab on either side of the incision (Fig. 189). The uterine wall being incised the membranes bulge through the wound; a finger should then be inserted between the membranes and the uterine wall, and the incision enlarged with scissors (Fig. 190). Very frequently

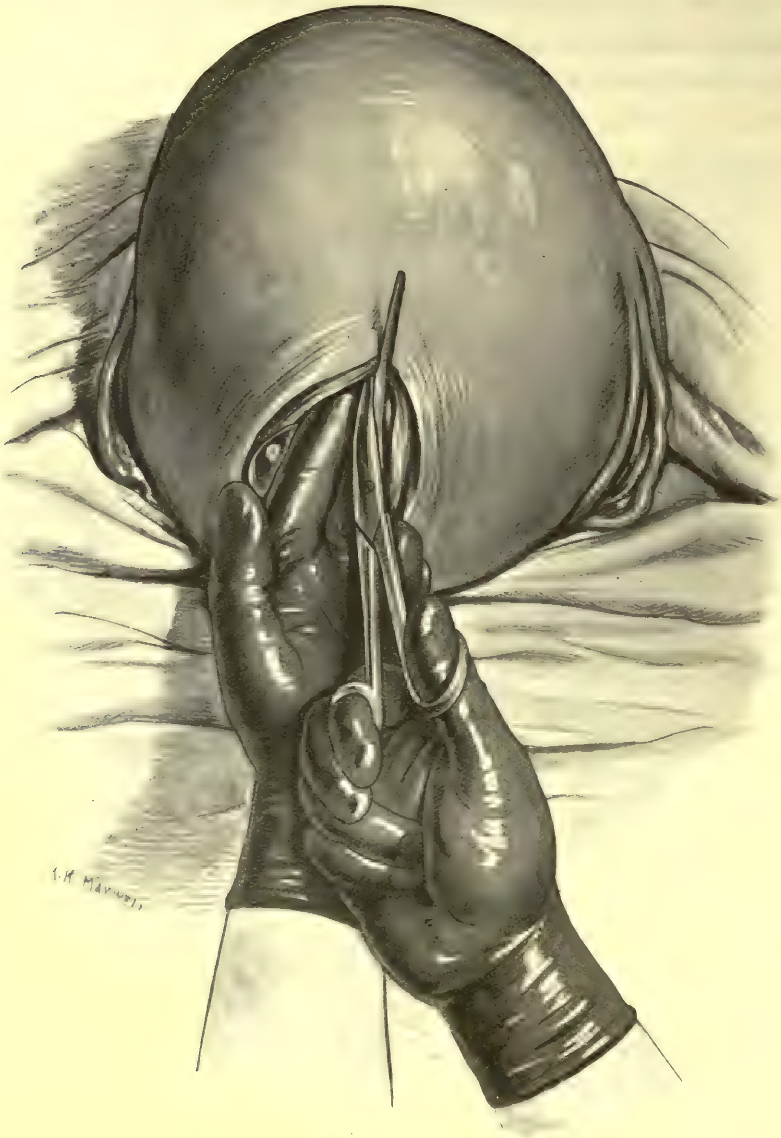

FIG. 190.—Enlarging the uterine incision. (*Operative Midwifery*, Munro Kerr.)

the membranes are ruptured during this proceeding, but this is of no great consequence.

Extraction of the Child.—The simplest way of extracting the child is to pass the hand into the uterus through the membranes or placenta and seize a foot (Fig. 191).

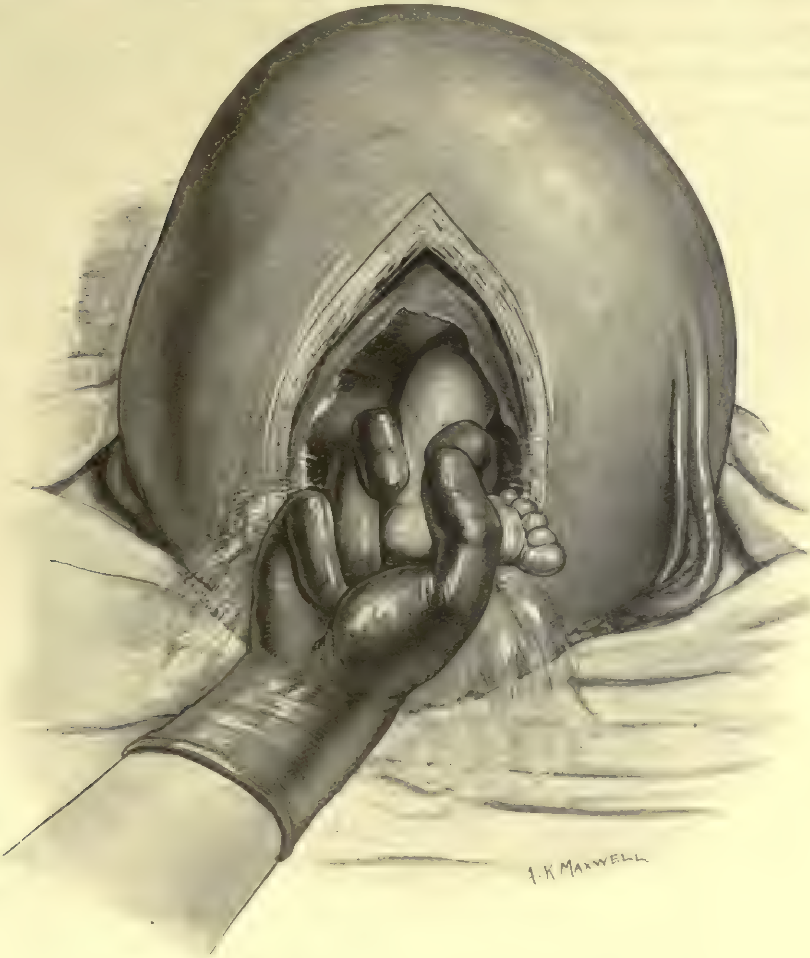

FIG. 191.—Extracting the child. (*Operative Midwifery*, Munro Kerr.)

It is much easier to extract the child by a foot than by the head. There is seldom any difficulty in the extraction, but if the liquor amnii has drained away and the uterus has retracted over the child, there may be a little trouble, and again if the labour has been long in progress and there is a marked retraction ring this may grasp the neck, and once or twice I have found difficulty in extracting the head in consequence. Most of the difficulty in extracting the child, however, results from the operator making too small a uterine incision and giving ergot prior to commencing the operation.

Once the hand has been pushed into the uterine cavity it must not be removed until the foot is seized, for pushing in and withdrawing the hand may injure the uterine wall, and if the uterus contracts there may be difficulty in extracting the child. The only injury which can occur during extraction is tearing of the lower end of the uterine wound, and I have seen this happen on one or two occasions when the child had been extracted roughly.

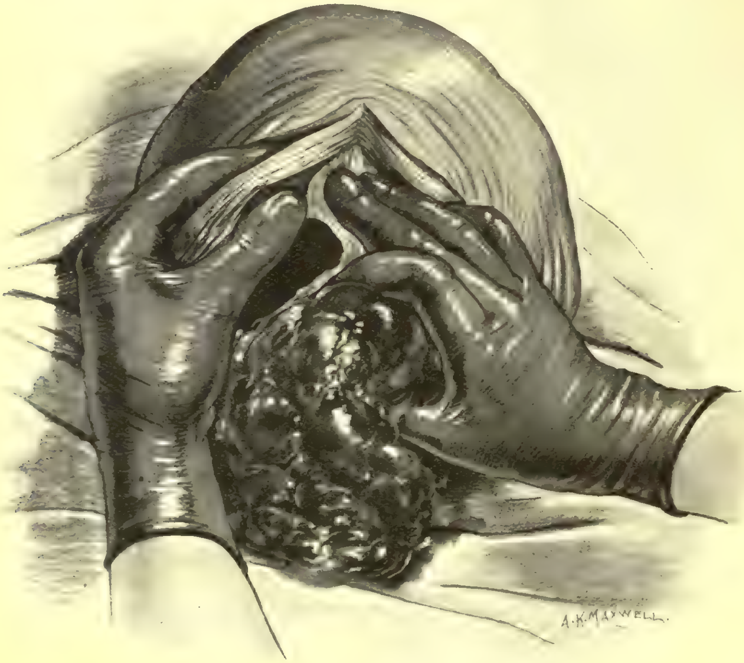

Fig. 192.—Removal of placenta and membranes. (*Operative Midwifery*, Munro Kerr.)

As soon as the child is extracted the cord should be clamped in two places and cut between; the child is then handed over to an assistant to be carefully attended to. In very many cases, indeed, the child is born in the condition of apnoea. This results from the absence of that congestion of the brain which occurs in the ordinary delivery by the natural passages.

Immediately the child is delivered, the assistant seizes hold of the uterus and surrounds it with gauze swabs.

Removal of the Placenta and Membranes.—The placenta and membranes must be most carefully removed (Fig. 192). The lowermost part is apt to be caught by the retraction ring, but with a little care all the membranes are easily withdrawn. My practice is to remove the placenta and membranes through the uterine incision, and in cases operated upon early in labour this is the only possible procedure. But when the membranes have been ruptured for some time and are bulging down into the vagina and have possibly been infected by repeated examinations, it is a distinct danger to pull the membranes up through the uterine wound. For some time, therefore, I have advocated that the placenta in such cases should be detached and expressed through the cervix. I shall refer to this matter later in connection with Caesarean section in " Suspect " and " Septic " cases.

Stitching the Uterus.—The general practice is to stitch the uterus in one layer. Eight or nine stitches are passed through the muscular and peritoneal coats; the mucous membrane is not included. The material used is silk or catgut according to the preference of the operator. In addition a continuous or a number of interrupted stitches are introduced to coapt more exactly the peritoneal surface (Fig. 193).

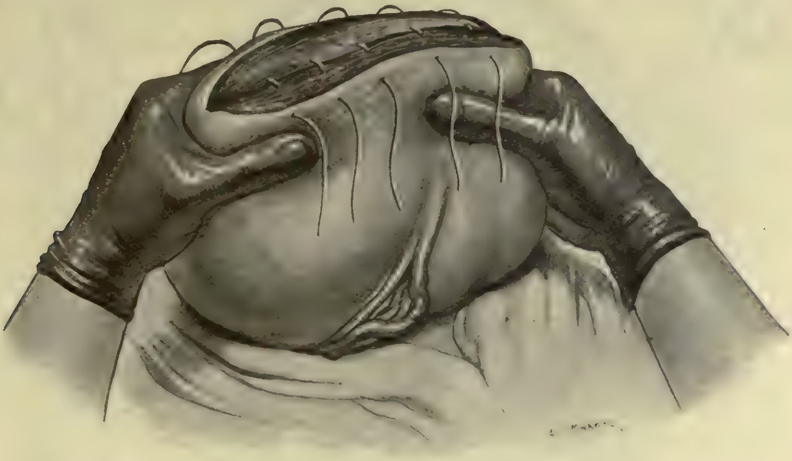

Fig. 193.—Stitching uterus with through-and-through sutures.

Until recent years this was the procedure I followed, but in the last two years I have employed a more elaborate method of stitching, with the object of securing a sounder uterine cicatrix. As will be observed in the illustration, four or five through-and-through stitches are first introduced. The mucous membrane and deepest layer of the muscular coat are then coapted by a continuous catgut suture, while the greater part of the thickness of the wound is coapted by a second layer of catgut (Fig. 194). I shall refer again to this matter of stitching the uterus when I consider the pros and cons for sterilization; all I wish to state here is that I am very hopeful that by this method of stitching I may be able to secure a particularly strong cicatrix.

I have found that the stitching of the uterus can be best carried out when the uterus is ‘ retracted ’ but not ‘ contracted,’ and so I think it is a mistake to give ergotine before operation. I have found that if the uterus is firmly contracted it is always difficult to get the edges of the wound in absolute apposition.

Sterilization.—Without doubt in the majority of conditions for which Caesarean section is performed the ideal procedure is to leave the woman unsterilized. Many of us feel this so strongly that we perform the operation two, three, or four times upon the same patient, and indeed Davis recently showed a photograph of the mother and her six children who had all been delivered by Caesarean section.

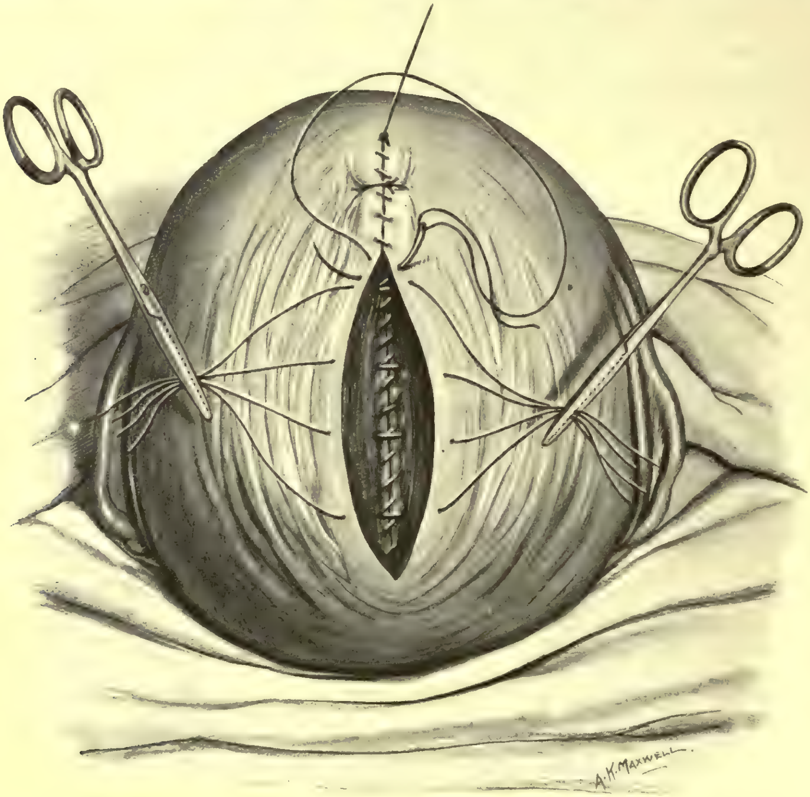

FIG. 194.—Present method employed by author; stitching the uterus in layers.

Now it appears to me that this question of sterilization is of supreme importance, because if it is proved beyond question that it is unsafe to leave a woman unsterilized on account of the danger of rupture during a subsequent pregnancy, or early labour, then it will be impossible to widen the scope of the operation to the extent many of us desire.

At the present time there is a considerable number of recorded cases in which the uterine cicatrix has given way in the later weeks of a subsequent pregnancy. Here are a few recent pronouncements on the subject: Couvelaire in his recent important work [1] reports that up to the present 50 cases of rupture have been recorded; Bar [2] mentions that rupture occurred four times in a series of 157 collected cases; Davis [3] reports that in a series of consecutive cases operated upon by himself rupture occurred three times; amongst my own cases rupture has occurred three times. In the majority of these cases two factors have contributed to this occurrence—infection of the wound and imperfect stitching.

Now theoretically it should be possible to secure an absolutely sound cicatrix, but in connection with the uterine wall there are certain conditions peculiar to it which may possibly influence union unfavourably and predispose to rupture of the scar. (1) The uterus during involution is undergoing degeneration. (2) The uterus is in a state of unrest, especially during the first forty-eight hours after operation. This disturbance may be ever so little, but at the same time it is just sufficient to interfere slightly with perfect union. (3) The uterine sutures are often employed not only as coaptors of the uterine wound but as agents to arrest bleeding. This, I think, is a matter of great importance. Many obstetric surgeons tie the uterine sutures tightly, more tightly than they would in stitching an ordinary wound. In the ordinary wound the operator arrests bleeding by ligating the cut vessels or by a temporary application of pressure forceps, but in the uterine wound that is not possible, and so the operator feels compelled to tie his ligatures tightly. This influences unfavourably the blood-supply, and is, I think, an unwise procedure. I have already described the method of stitching the uterus which I employ at present. (4) The sheets of muscles which form the uterine wall are irregularly distributed. (5) A cicatrix in an ordinary muscle wound consists of connective tissue, and I believe the same applies to the uterine wall. I very much doubt if in the uterine scar the connective tissue is ever replaced by muscle, and this seems to be the opinion of most recent writers on the subject, as, for example, Couvelaire. (6) Implantation of the placenta over the uterine scar in a subsequent pregnancy. If we admit that the uterine scar consists of connective tissue, it follows that, should the placenta become implanted over the scar, there will be a greater possibility of rupture, for, as we know, the trophoblast and chorionic villi have a peculiarly destructive effect on connective tissue.

I believe these factors are of some importance, and do occasionally unfavourably influence the perfect healing of the uterine scar. If, however, one stitches the uterus in layers, and if one takes every possible care to prevent infection, a sound cicatrix will generally be secured.

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[1] *Introduction à la Chirurgie utérine obstétricale*, p. 140, Paris, 1913.

[2] *La Pratique de l'Art des Accouchements*, 3rd edition, vol. ii. p. 965, 1914.

[3] *Amer. Journ. Obst.* vol. lxviii. p. 1017, 1913.

Very naturally the question will be asked, If it is impossible to secure a sound cicatrix will the classical conservative operation require to be abandoned, and must we sterilize all the patients ? I sincerely hope not, for at the worst we have still the lower uterine segment to work upon, and it seems to me just possible that a sounder cicatrix may be secured by incising that area which does not become stretched to any great extent until labour has been in progress for some time. As I shall explain when referring to the extraperitoneal Caesarean section, it is for this reason and this reason alone that I withhold expressing any decided opinion against this operation.

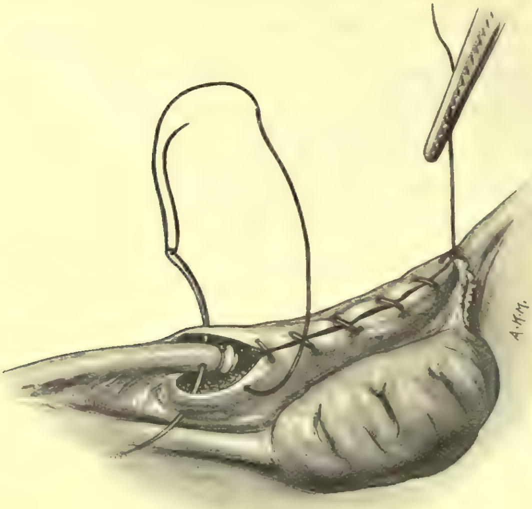

Fig. 195.—Method of sterilization.

Method of Sterilization.—Should sterilization be determined upon, the best procedure is to remove a portion of the tube and bury the uterine stump under a fold of peritoneum (Fig. 195). I entirely disagree with those who maintain that if the patient is to be sterilized the uterus should be removed. The uterus should only be removed if there is some indication for doing so.

Closing the Abdominal Wound.—The method employed by the author is indicated in the illustration (Fig. 196).

After-Treatment.—It is unnecessary to consider this subject in detail as it is in most respects identical with the after-treatment of abdominal operation in general. I shall only refer, therefore, to a few points which I think are worth attention.

In my experience sickness and vomiting, so common after abdominal operations, are distinctly less frequent after Caesarean section. I have found that the sickness is best controlled by giving the patient no fluid for twenty-four hours, and then only sips of hot water. If sickness persists for more than twenty-four hours, I give small doses of milk of magnesia, and should this fail to stop the sickness I wash out the stomach.

A very troublesome complication is bronchitis, especially in rachitic patients operated upon immediately after their admission to hospital.

The most dreaded complication of course is sepsis, and undoubtedly the conditions in the uterus after delivery are peculiarly favourable to such an occurrence. On looking over a long series of cases of Caesarean section it will be found that a considerable number show evidence of more or less serious sepsis. In the vast majority of such cases the infection occurs prior to the operation, and is the result of repeated vaginal examinations. In absolutely clean cases sepsis should never occur.

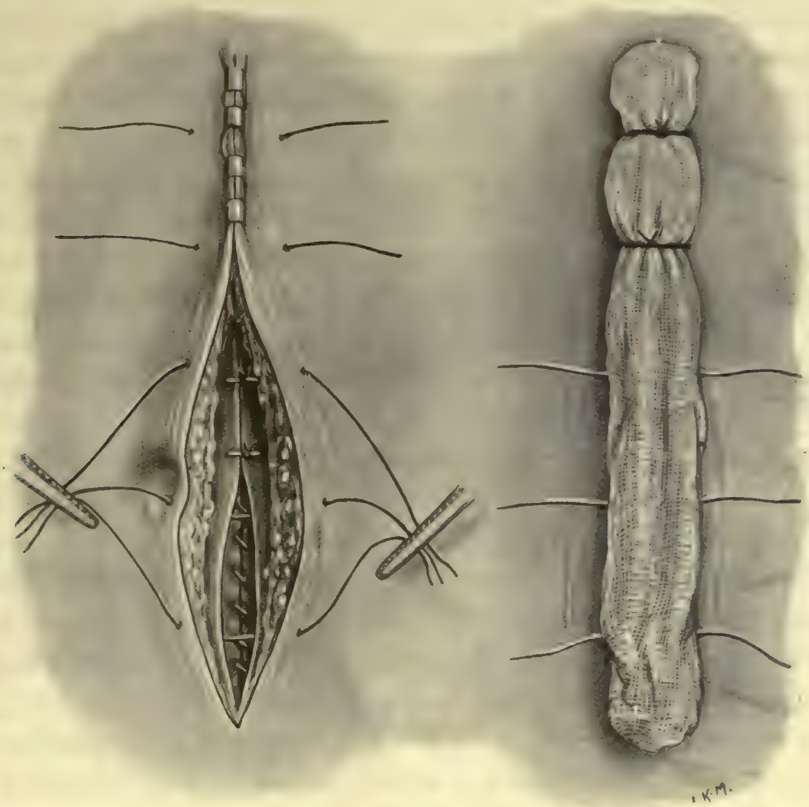

Fig. 196.—Method of closing and dressing the abdominal wound employed by author. (*Operative Midwifery*, Munro Kerr).

Should sepsis manifest itself there are three courses open to the surgeon: (*a*) to trust that the resistance of the individual will overcome it, the course usually followed; (*b*) to douche out the uterus, a procedure not entirely free of risk; (*c*) to perform hysterectomy. Undoubtedly the third course is the soundest when the condition becomes serious, for infection invariably begins in the interior of the uterus and spreads thence to the peritoneal cavity, cellular tissue, and lymphatics.

As regards dressing the wound this is not necessary in the majority of cases until the stitches are removed on the tenth day. The patient is usually allowed up on the seventeenth day or sometimes earlier, and leaves the hospital at the end of the fourth week. No abdominal belt is necessary.

In the majority of cases the patient can nurse her child on the second or third day after the operation.

The Results to Mother and Child.—The results of Caesarean section as regards the mother and child depend upon several factors. Amongst these the most important are the nature of the condition for which the operation is performed and the condition of the patient at the time of operation, more especially as regards possible infection.

With regard to the first factor, the results are very much better when the operation is performed for contracted pelvis, placenta praevia, fibromyomata, or ovarian cystomata than when it is performed for such grave conditions as eclampsia, concealed accidental haemorrhage, or impacted shoulder presentation. I have already referred to the operation performed for these conditions.

With regard to the other factor, the results depend very much upon the condition of the patient at the time of the operation. The investigations of Renolds in America and more recently those of Routh in this country have proved that the maternal mortality in contracted pelvis from Caesarean section depends chiefly upon the condition of the patient at the time of operation. Routh has shown by his tables that in women operated on prior to or early in labour, and before any examinations have been made by practitioner or midwife, the maternal death-rate is 2 to 3 per cent, while in women operated upon when advanced in labour, and after many examinations, and especially after attempts at delivery have been made, the maternal mortality is from 20 to 30 per cent.

Cases of Caesarean Section (Routh)[1]

Condition.	Cases.		Maternal Deaths.		Percentage.	
A. Not in labour	245	469	9	14	3·6	2·9
B. In labour, membranes unruptured	224		5		2·2	
C. In labour, membranes ruptured	116	230	18	40	10·8	17·3
D. Frequent examinations or attempts at delivery	64		22		34·3	

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[1] *Journ. of Obst. and Gyn. of British Empire*, 1911, vol. xix. pp. 1-233.

My own experience is entirely in agreement with Routh's table. During the years 1901–1913 I and my assistant performed Caesarean section for contracted pelvis in 110 cases, with a maternal mortality of 7·2 per cent. But if one takes the presumably non-infected cases, which number 75, that mortality is 5·3 per cent, while in the certainly infected and possibly infected cases, numbering 35, the mortality is 10 per cent.

In the discussion upon Caesarean section which took place at the Royal Society of Medicine in the spring of 1911, Tait recorded 40 cases presumably not infected operated upon by him without a death, and 8 cases certainly or possibly infected with 1 death. Equally good results were recorded by Griffith, Russell, and others.

What we are now specially concerned with, then, is improving our technique so that we can safely deal with ' suspect ' or infected cases. In this connection let me describe first of all my own method for dealing with such cases. I suggested it some years ago, and quite independently it was recommended by Edge. I thoroughly cleanse the vagina and cervix. After opening the abdomen I bring the uterus out and carefully surround it with towels before I open it. I then make the ordinary uterine incision, and remove the child and wash over the uterine wound with saline solution. I then remove all the soiled towels and place fresh ones round the uterus. My assistant and I also put on fresh gloves. Having done this, I push the placenta and membranes by means of gauze down through the cervix into the vagina, for I believe that in pulling up the placenta and membranes through the uterine wound there is a great risk of carrying infection up into the uterine cavity. I have employed this method in 6 infected cases, in 3 of which streptococci were found in cultures taken from the cervix before operation. All of these cases recovered.

The general recommendation for dealing with infected or presumably infected cases is Caesarean section with panhysterectomy, but my own feeling in the matter is that when the pelvis is not too small, craniotomy is a wiser proceeding, even although the child is alive. Hysterectomy should only be employed as a *dernier ressort.* It is a confession that our surgical technique is still imperfect, and must only be adopted where it is certain that every other procedure is attended with greater danger to the mother. I expect that the question of how to deal with the uterus after Caesarean section will be much discussed for some time to come. Let us hope that the final decision will not be in favour of hysterectomy.

Other suggestions have been made for dealing with infective cases, such as extraperitoneal section, washing out the amnionic cavity, washing out the uterus with cultures of the lactic acid bacillus, stitching the uterus to the abdominal wound, so that if suppuration does occur a uterine fistula would be established. Personally, I doubt if these suggestions will prove of much value. But undoubtedly an autogenous vaccine made from cultures taken from the cervix might act beneficially, and such a vaccine should be given as soon as possible.

The *foetal mortality* in Caesarean section should be *nil*. Unfortunately in my series of 110 cases there were two foetal deaths. In the one case in which I was responsible, I heard the foetal heart two hours beforehand. Such an occurrence as delivering a dead child by Caesarean section, especially if the pelvis is of such a size as to permit of craniotomy being performed, is truly a most unfortunate occurrence, and must be guarded against with the greatest care.

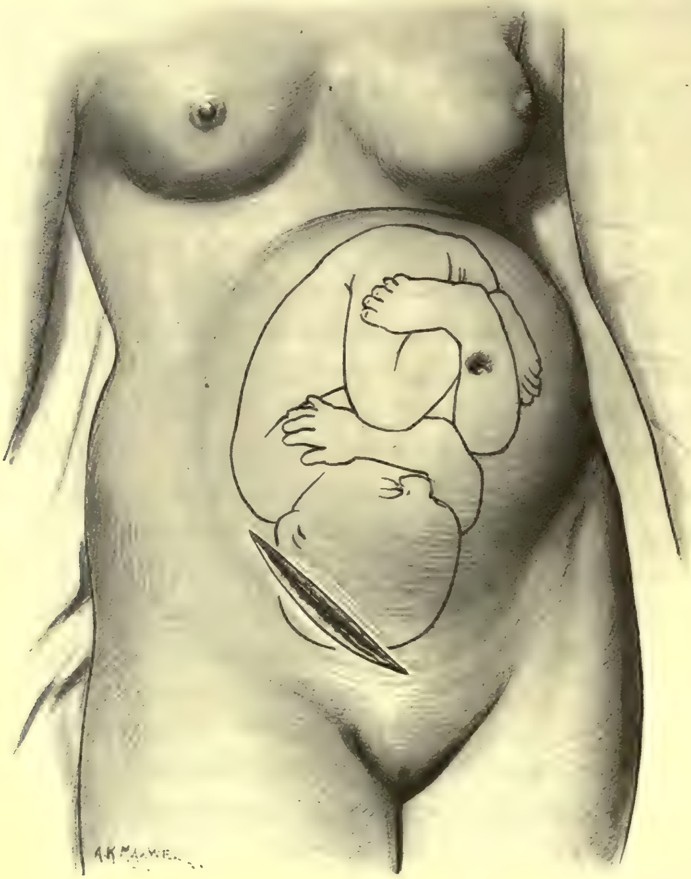

Fig. 197.—Extraperitoneal section : line of incision.

Extraperitoneal Caesarean Section.—For a number of years past there has been a good deal written on this subject. A history of the evolution and development of the operation will be found in such monographs as those of Jennenin[1] and Döderlein.[2] Personally, I have no experience of the operation, but as far as I can judge, Döderlein's method is the one most favoured. It is really a modification of Latzko's operation.

Döderlein, instead of employing a Pfannenstiel incision, makes an incision parallel to Poupart's ligament from the symphysis pubis to the anterior superior spine (Fig. 197). He cuts through skin, fascia, and muscles, securing and tying any bleeding vessels. Having reached the cellular tissue, he pushes it aside, and defines the lateral border of the bladder, which he pushes over towards the middle line, The lower limit of peritoneum is not observed. He then renders the surface of the uterus (lower segment) clear by separating off the loose cellular tissue and securing any bleeding vessels. Having done this, he makes a vertical incision into the

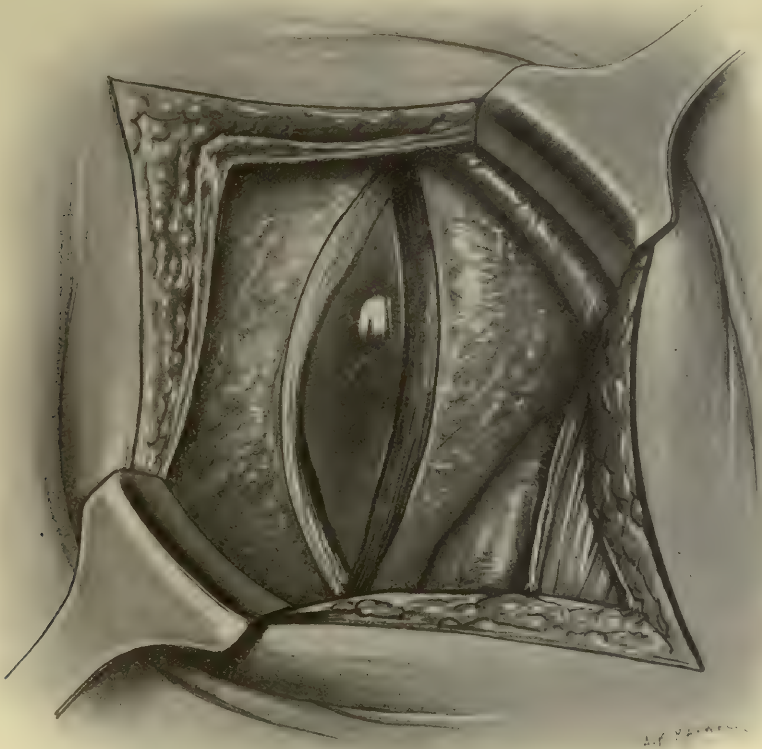

Fig. 198.—Incision in uterus showing membranes exposed.

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[1] *L'Obstétrique*, August 1909.

[2] *Monatsschr. f. Geb. und Gyn.*, January 1911.

uterus two fingerbreadths from the margin of the bladder (Fig. 198). The child is extracted with forceps if the head is the presenting part, or by traction on the limbs if the breech presents (Fig. 199). The placenta is expressed or removed by hand. The stitching of the uterine wound is very simple, as the wall is so thin. A continuous catgut suture is employed (Fig. 200). Döderlein employs a second layer of continuous suture, by means of which he brings some cellular tissue over the wound. He then closes the abdominal wound.

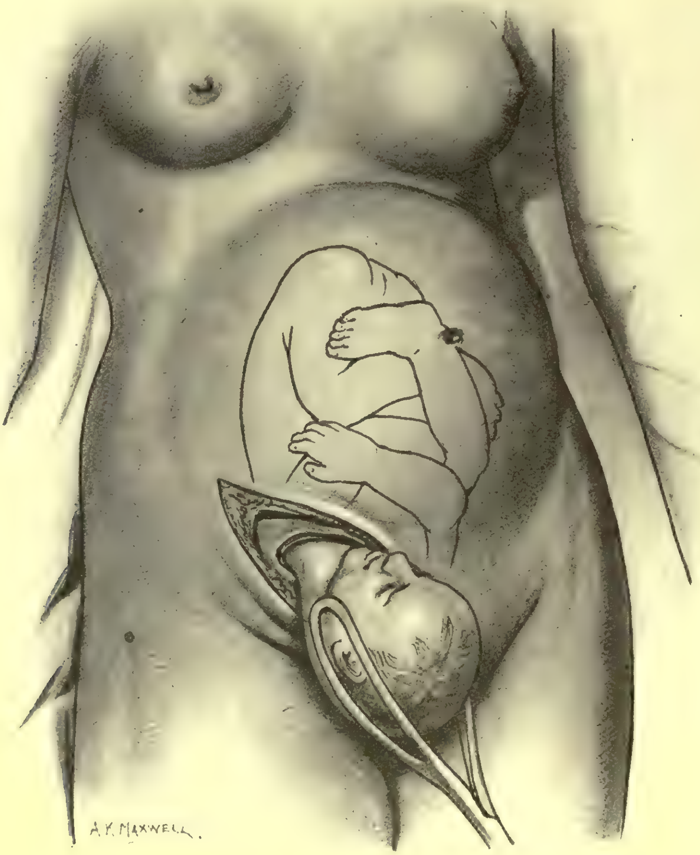

Fig. 199.—Extraction of child with forceps.

In Great Britain there are few who advocate the operation, but Russell and Tweedy have written in its support.

When it was introduced the operation was advocated as being specially suitable for septic cases; it is very doubtful if this has been proved to be the case. There are several objections to the operation; it is more difficult and more dangerous to the mother on account of the greater risk of haemorrhage and injury to the bladder; it is also more dangerous to the child. As far as I can judge, it presents no advantage over classical Caesarean section, and will entirely disappear and be forgotten unless it is proved that the cicatrix in the lower segment is decidedly stronger than one situated in the upper part of the body of the uterus.

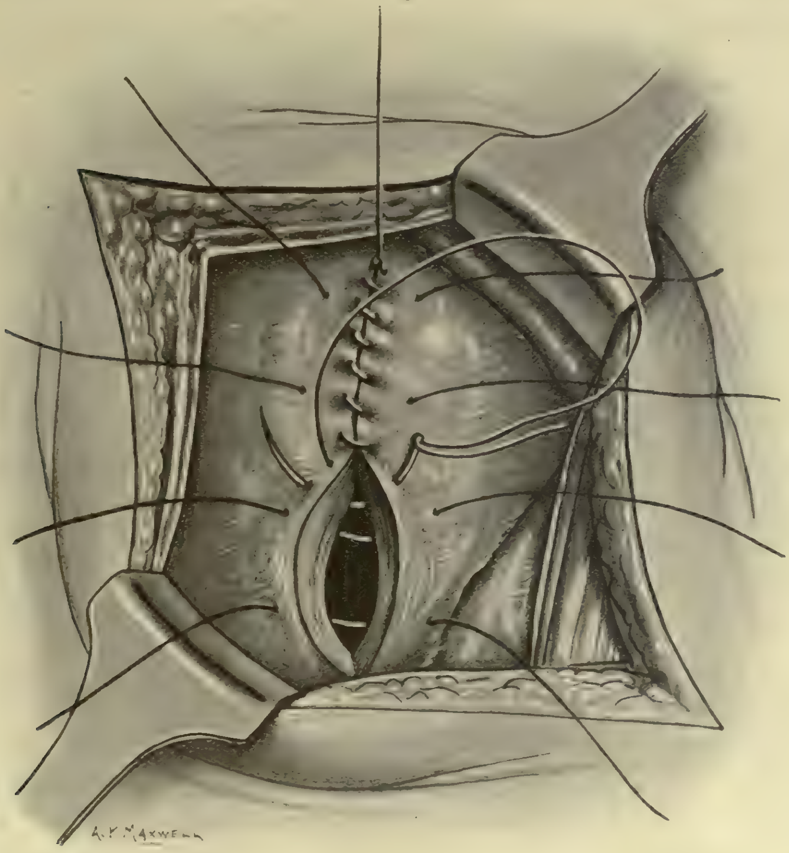

Fig. 200.—Stitching the uterine wound.

B. Abdominal Caesarean Section followed by Hysterectomy

I. Subtotal Hysterectomy.—Removal of the uterus by supravaginal hysterectomy is indicated in cases where myomatous tumours are too extensive or too numerous to permit of simple myomectomy; when post-partum haemorrhage cannot be controlled; in most cases of accidental haemorrhage when Caesarean section is employed; and in women the subjects of osteomalacia. All these indications are self-evident and need no elaboration, with the exception of post-partum haemorrhage. This condition I have only once observed. The patient had been long in labour, and was driven some twenty miles before operation. All other operators of experience have remarked upon the infrequency of post-partum haemorrhage after Caesarean section.

It will be observed that I do not include septic infection of the uterus or rupture of the uterus, for in both of these conditions I am convinced panhysterectomy gives the best results, for the simple reason that if one leaves the cervix behind in these conditions, one leaves the part that has been most infected by the vaginal examinations and manipulations carried out prior to the delivery of the child.

The modern method of supravaginal amputation consists in securing the uterine and ovarian vessels on both sides by ligatures, amputating the uterus supravaginally, stitching the stump, and finally bringing the peritoneum by a continuous suture over the stump—a method which is correctly described as ‘ retroperitoneal ’ or ‘ subperitoneal ’ treatment of the stump. The details of the operation, which has been fully described in a preceding article (p. 471), are briefly as follows : The patient is placed in the Trendelenberg position, and the intestines are carefully walled off with swabs. The uterus, being pulled out of the abdomen, is dragged over to one side by the assistant, so as to allow the operator to reach the broad ligament of the opposite side. The haemorrhage from the wound in the uterus is controlled by a long clamp or by rapidly stitching up the uterine wound (Fig. 201). Clamps are now applied, first to the round ligaments and then to the ovarian vessels, either beyond or on the uterine side of the ovary, according as the operator decides to remove or leave the latter behind. A clamp is then applied close down the side of the uterus, to control any bleeding from the ovarian vessels on the uterine side.

The securing of the uterine vessels—the next step—is the only troublesome one in the operation. Prior to attempting to secure them, however, the peritoneum on the anterior uterine wall should be divided transversely, just above where it is reflected on to the bladder. In doing this the peritoneum alone should be seized with dissecting or pressure forceps and cut across. If one catches it carelessly, the subjacent cellular tissue, which contains numerous dilated vessels, will be injured, and profuse bleeding will result. The bladder is then pushed down out of the way with a gauze swab. The peritoneum behind the uterus is also divided. One has now opened up the lower part of the broad ligament, and the uterine vessels of each side can be readily seen and felt. The vessels are secured by clamps applied close to the cervix in case of injuring the ureters, although there is really not much chance of doing this if the bladder has been pushed well out of the way. Having secured both uterine vessels they are divided close by the uterus.

The cervix should now be grasped with volsellum forceps below the level at which it is to be divided ; it should then be cut across and the body of the uterus removed.

All the vessels which have been clamped must now be ligated, and this I prefer to do by under-stitching. There now remains only the stitching of the stump, which is steadied by the volsellum forceps. Prior to doing this, however, I am in the habit of swabbing out the cervical canal with pure carbolic acid ; others use the Pacquelin cautery, or dissect out the mucous membrane. I do not attach great importance to these steps, and many operators dispense with them altogether. The actual stitching of the cervix must be done with care. I usually do it in two layers. The sutures, which are of catgut, are passed through the anterior and

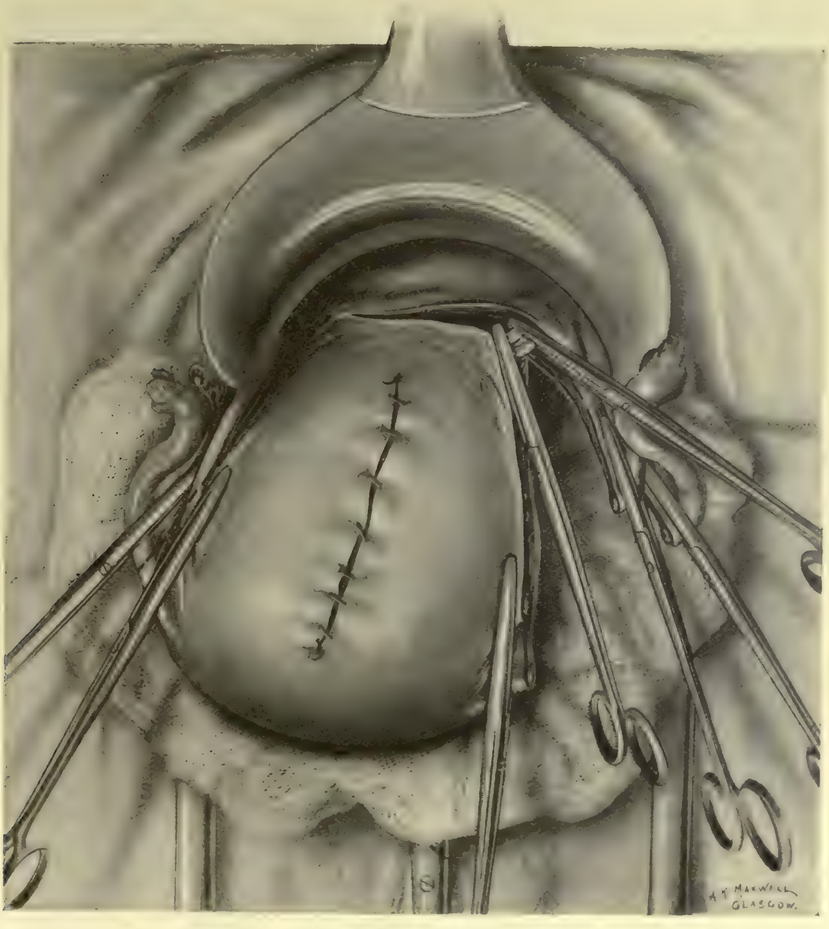

Fig. 201.—Subtotal hysterectomy.
Uterine wound closed by continuous catgut, transverse incision across cervix with bladder separated, all vessels except left uterine secured by clamps. (*Operative Midwifery*, Munro Kerr.)

posterior walls of the cervix, but do not include the mucous membrane. The amount of stitching that is necessary depends upon the width of the cervix. In the case of a dilated cervix the stump to be stitched is very broad, so that five deep and two or three superficial sutures are required, while on the other hand, if the cervix has not been dilated and the stump is quite small, two deep and one or two superficial sutures are sufficient.

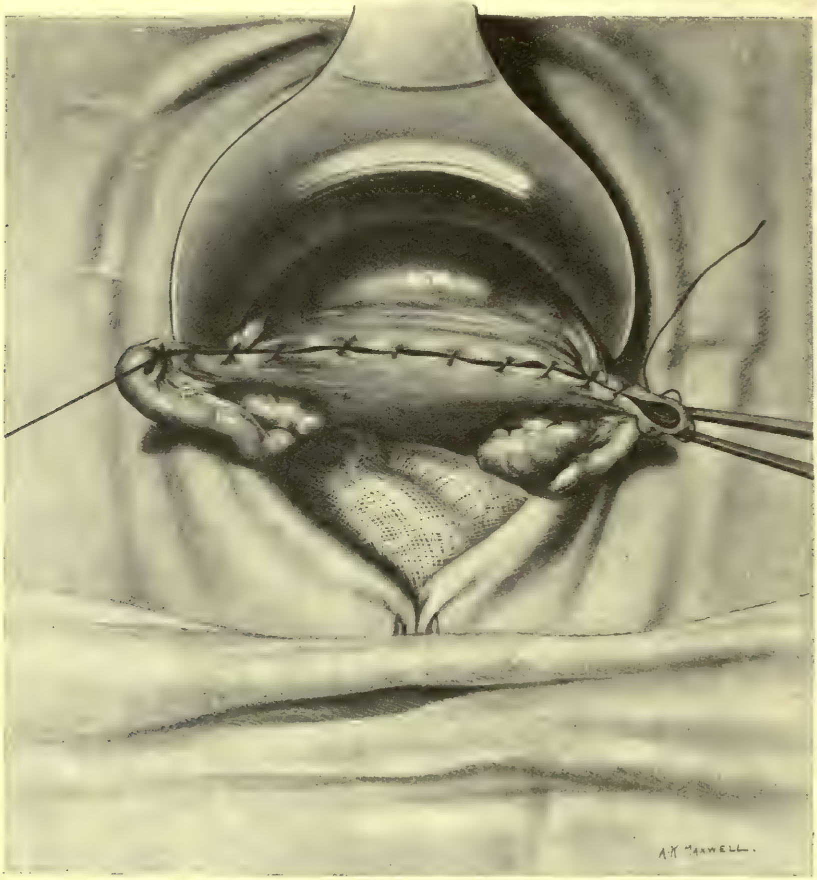

Fig. 202.—Subtotal hysterectomy.
Cervix has been closed and stump covered with peritoneum. (*Operative Midwifery*, Munro Kerr.)

Having satisfied one's self that there is no bleeding point unsecured, the peritoneum is carefully stitched over the stump, and the raw surface of the broad ligament brought together with a continuous catgut suture (Fig. 202). All blood-clot is now removed, and if the patient is at all collapsed one or two pints of normal saline solution are poured into the abdomen. The closing of the abdomen is carried out in the usual manner.

II. Complete Hysterectomy. Panhysterectomy.—When the uterus has to be removed, a few operators prefer total hysterectomy in all cases. But whether or not this method should always be employed when the uterus is removed, panhysterectomy is certainly indicated in septic cases, in most cases of rupture, and in all cases of carcinoma of the cervix where it is possible to remove the malignant growth.

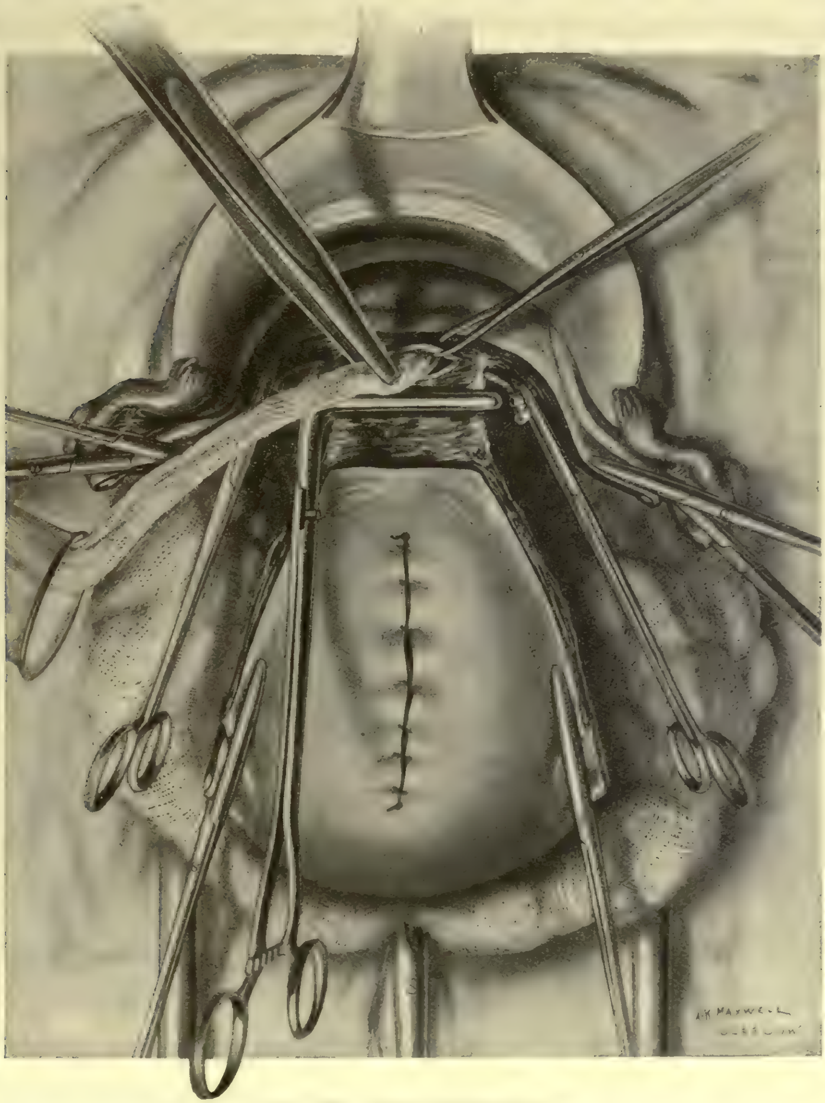

Fig. 203.—Panhysterectomy.
All the vessels secured, vaginal wall clamped; gauze being passed into lower part of vagina.
(*Operative Midwifery*, Munro Kerr.)

The steps in the operation are, up to the point of clamping the uterine vessels, the same as those followed in supravaginal amputation. The bladder must now be pushed farther down, and the tissues around separated from the cervix and the upper part of the vagina. The latter is then clamped with strong angled forceps (Fig. 203) similar to those used in Wertheim's operation (p. 495). The vagina is then divided below and gauze is packed into the canal ; I prefer this device to employing a second Wertheim clamp. This prevents any of the uterine discharges contaminating the peritoneum. The anterior and posterior vaginal walls are then stitched together (Fig. 204), special care being taken at the corners, for there is apt to be a little venous oozing there. In septic or suspected septic cases many prefer to leave in a gauze drain, and only partially close the vagina, but personally I prefer to close the vagina completely. When the operation is finished the gauze in the vagina should be removed.

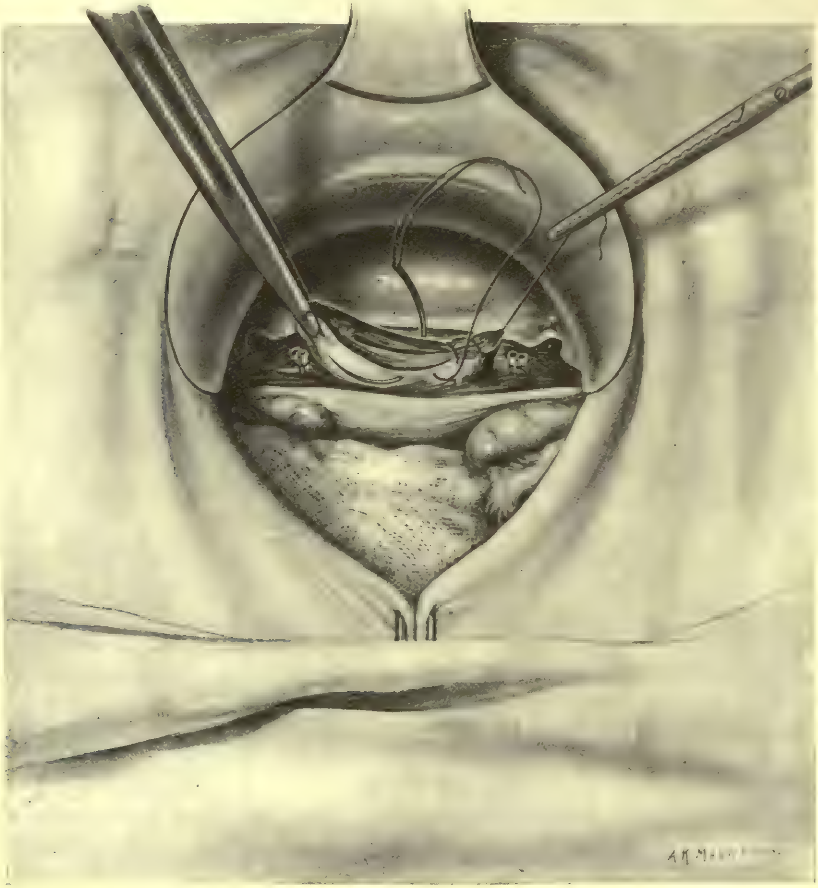

Fig. 204.—Panhysterectomy. Stitching vaginal wall.

C. Myomectomy on the Gravid Uterus

The general indications for operative interference upon fibromyomata of the uterus and especially upon fibromyomata complicated by pregnancy, does not fall within my province; it is considered elsewhere (Vol. II. p. 296). I have been asked simply to deal with the operation of myomectomy upon the gravid uterus. But to do this I must briefly indicate under what circumstances the operation should be performed.

Indications.—In approaching this subject the first important point I must emphasize is that the mere presence of a fibroid tumour in a gravid uterus is not an indication for hysterectomy or myomectomy. As a matter of fact, those of us who have had long and extensive experience of obstetrical as well as gynaecological practice have found that these major operations are seldom necessary. In the many cases of fibromyomata of the uterus complicated by pregnancy which have been under my care, I have had to perform abdominal section only seven times. On the other hand it must be clearly understood that the extreme conservatism of some obstetricians is most unwise. No doubt a number of cases are subjected to abdominal section unnecessarily, but it is certain that others are deprived of the benefit that would result from myomectomy or even hysterectomy, by extreme conservatism. Now that hysterectomy has a mortality of 2 to 3 per cent and myomectomy a mortality of 3 to 4 per cent, it is most unfortunate when an attitude of conservatism is pushed beyond its proper limits. Operative interference is unnecessary so long as the patient is comfortable and is not suffering any disturbances from mechanical pressure, pain, etc., but on the other hand it is indicated when disturbing symptoms appear, and do not yield to or cannot be kept under control by the ordinary methods of treatment. Speaking generally, it is not advisable to delay when ‘ pressure symptoms ’ become marked and are not relieved by rest and the ordinary medical remedies, neither is it wise to delay when the tumour itself assumes very large dimensions or degenerative changes are suspected. The pressure symptoms associated with the condition are referred to elsewhere. They include all the discomforts, pain, and disturbance of functions following upon mechanical pressure on bowel, bladder, blood-vessels, and nerves. It will be observed that I made the proviso that pressure symptoms are an indication for interference when they are not relieved by treatment, such as rest, diet, tonics, etc. And I have made this proviso because I have seen a great number of cases in which by such treatment it has been possible to allow a pregnancy to continue to term even when circumstances looked at times by no means encouraging. I had under my charge some months ago a patient who was recommended to have hysterectomy in the early months of pregnancy, but with the careful assistance of her medical attendant we were able to delay Caesarean section and hysterectomy until term, and in this manner secured a living child.

The degeneration of fibroid tumours in pregnancy is a peculiarly interesting subject. Several British gynaecologists, as, for example, Bland-Sutton, Spencer, Fairbairn, Donald, have made important contributions to it. Of all these degenerations the most interesting is the ‘ red ’ degeneration which is so frequently associated with pain and tenderness in the tumour and sometimes, as in a case recently operated upon, with sickness and vomiting.

When possible myomectomy should be delayed until the last two or three weeks of pregnancy because, although in many cases, as we shall see, expulsion of the foetus does not follow the operation, there is a certain number of cases in which it does. In judging of the value of myomectomy during pregnancy, therefore, two points have to be considered—the mortality from the operation, and the frequency with which abortion or premature labour follows it.

In recent years the most complete study of the subject of fibromyoma in relation to pregnancy and labour has been made by Troell.[1] This author shows in a most interesting table (xxvi. p. 430) that the primary mortality has been steadily falling in recent years, and that in his 157 collected cases it was only 3·9 per cent. I have made a much less complete analysis of the cases since that date, and have found that the mortality is now only 2·5 per cent—just a little greater than the mortality from hysterectomy. The slightly greater mortality from myomectomy as compared with hysterectomy is readily understood. It holds good under all circumstances, and is observed in all cases operated upon, no matter whether the women are pregnant or not.

With regard to the tendency to abortion or premature labour Troell found in his collected cases that this occurred in 23 per cent of cases of enucleation, but only in 9 per cent where a simple division and ligature of the pedicle was performed. Further, he brings out this interesting fact that the relative frequency of expulsion of the ovum differs according to the age of the pregnancy. When myomectomy was performed in the first half of pregnancy expulsion of the ovum occurred in only 14·4 per cent, but where the operation was performed in the second half it occurred in 30 per cent of cases.

Very often it is impossible before the abdomen is opened to say definitely whether myomectomy or hysterectomy should be chosen, and indeed after the uterus is exposed it is not even then easy to decide, for some operators would only think of myomectomy if the tumour was single and not too deeply embedded in the wall, while others might be inclined to perform it even although the tumours were multiple and in removing them the membranes even had to be exposed. The matter must be left to the judgment of the operator, who, while endeavouring to be as conservative as possible, must never carry conservatism to extreme limits.

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[1] *Studien über das Uterusmyom in seinen Beziehungen zu Konception, Schwangerschaft, Geburt, und Wochenbett,* Stockholm, 1910.

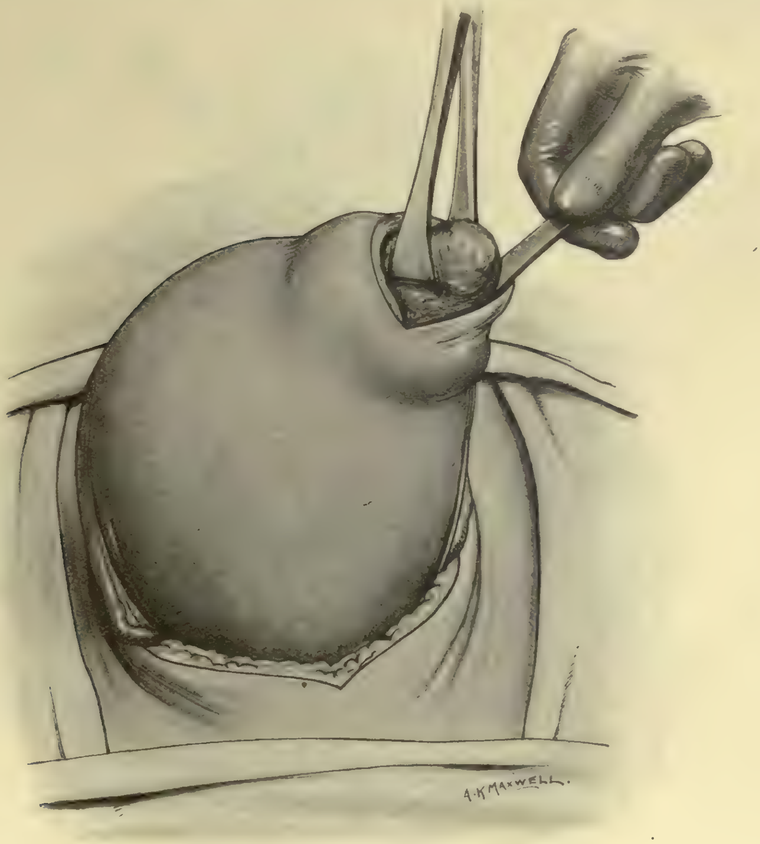

Fig. 205.—Myomectomy. Removal of myoma.

The actual removal of the tumour is seldom difficult, indeed myomectomy is much easier in the gravid than the non-gravid uterus. Very naturally the bleeding is sometimes profuse, but there is often much less haemorrhage than might be expected.

When the tumours are exposed one has the choice of incising the uterine wall either longitudinally or transversely, and there again sometimes one direction is better, sometimes the other. It is always better, however, to make the incision over the most prominent part of the tumour. This having been done, the operator should carefully shell it out. He will usually do this best by making a little traction on the tumour with volsellum forceps (Fig. 205).

Having removed the tumour he should stitch up the raw surface in layers so as not to leave any dead space (Fig. 206). Speaking generally, the bleeding that occurs is an oozing which can only be controlled by carefully coapting the surfaces. Frequently the application of very hot saline solution arrests the oozing and occasionally separate bleeding vessels can be secured, and this should always be done if possible. The abdomen must only be closed when bleeding has been entirely arrested.

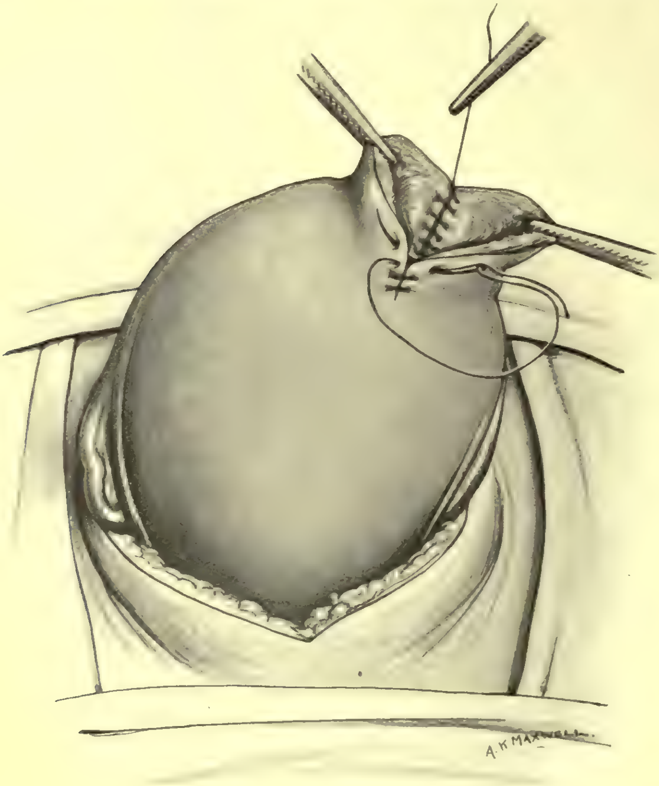

Fig. 206.—Myomectomy. Closing uterine wound in layers.

During the operation and for a day or two after it is advisable to keep the patient lightly under the influence of morphia, and naturally it is of supreme importance to carry out all the manipulations on the uterus and tumour with the greatest gentleness.

D. Enlarging the Cervical Canal by means of Incisions—Vaginal Hysterotomy—Vaginal Caesarean Section

Incisions of the Cervix.—Before considering the latest and most extensive method of incising the cervix known as Vaginal Caesarean Section I must refer briefly to the small incisions of the cervix which have been employed from early times in certain conditions, as, for example, atresia of the cervix and rigidity of the cervix.

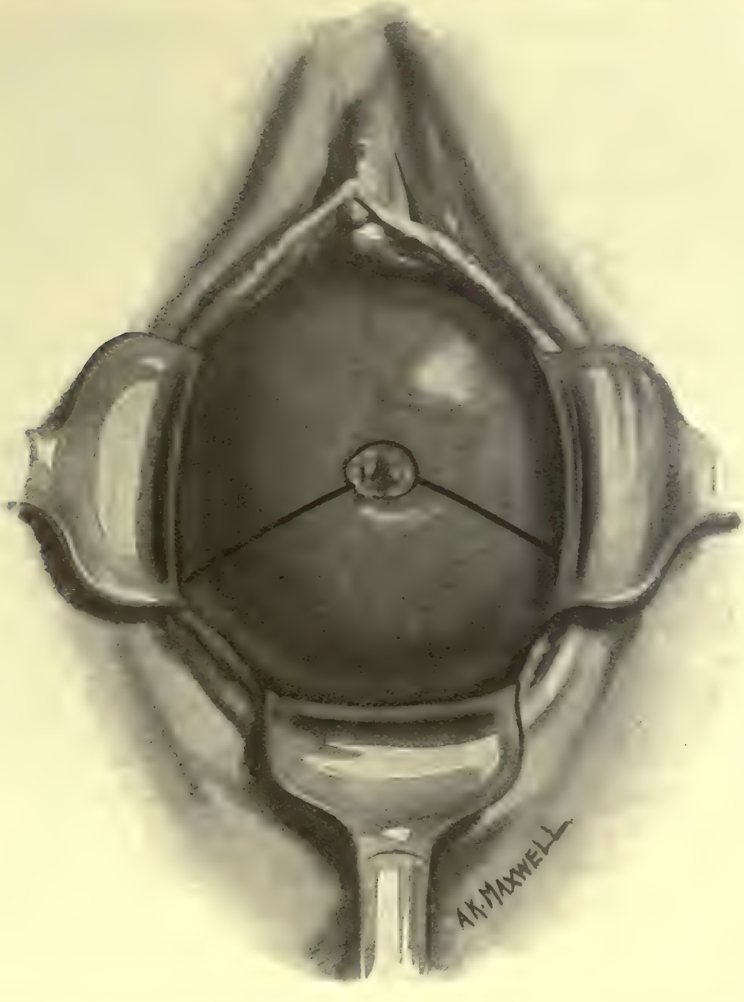

Fig. 207.—Incision of cervix when the latter is taken up, but the os externum is only slightly dilated. Dark lines show the direction in which incisions should be made. (*Operative Midwifery*, Munro Kerr.)

In atresia of the os externum a crucial incision should be made over the os externum and labour allowed to proceed. In rigidity of the cervix, when that condition does not yield to opium, chloral, or the local application of cocaine, multiple small incisions with scissors are usually recommended. Sometimes these are sufficient but on other occasions they are not, and deeper incisions have to be made. They should only be employed, however, if the cervix is completely taken up. The illustration (Fig. 207) explains the direction of the incisions. Prior to employing them the vagina and vulva are thoroughly cleansed and disinfected, and the patient placed in the lithotomy position and brought to the edge of the couch. Scissors will be found a more suitable instrument than a knife for making these incisions.

The advantage of this method of operation is that the uterus can be rapidly emptied and with less shock than if the cervix is dilated manually or by instruments. In certain cases, *e.g.* valvular disease of the heart, this question of shock is a very important one. After delivery is completed the incisions should be carefully stitched.

Vaginal Caesarean Section.—Within the last few years incisions of a very much more extensive nature have been employed. The names of two obstetricians deserve special mention in connection with the subject—Dührssen and Acconci. I do not intend considering who should have priority. Those interested in the question will find it fully discussed by Dührssen. Since Acconci's death Dührssen's name has come to be almost universally associated with the operation. He first described it in 1895. His monograph, entitled *Der vaginale Kaiserschnitt*, appeared the following year. The operation is generally referred to as " Vaginal Caesarean Section,"[1] and certainly from the extent of the incisions now employed the term is not out of keeping with the magnitude of the operation.

The ease or difficulty in performing the operation of vaginal Caesarean section depends chiefly upon the size of the uterus and the age of the pregnancy. In the first half of pregnancy the uterus can be pulled down, and the uterine contents removed through a much smaller opening than if pregnancy is more advanced. I shall describe the operation for the simpler cases, and then indicate the more extensive incisions which may be necessary when the foetus has to be removed in the later weeks of pregnancy.

The patient is placed in the lithotomy position and the vulva and vagina thoroughly cleansed. With a retractor the assistant pulls back the posterior vaginal wall. The cervix is then seized laterally by two volsellum forceps, which are replaced by two ligatures as the latter take up less room. A transverse incision is now made across the cervix immediately below the reflexion of the bladder. The transverse incision should embrace the anterior half of the cervix (Fig. 208). It is well also to make a longitudinal incision when operating in the later weeks of pregnancy. The bladder is pushed out of the way with the fingers (Fig. 209) both in the middle line and at the sides. It is most important to separate the bladder completely.

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[1] The term " Vaginal Caesarean Section " is not new; it is referred to by Baudelocque (Heath's trans., vol. iii. p. 351).

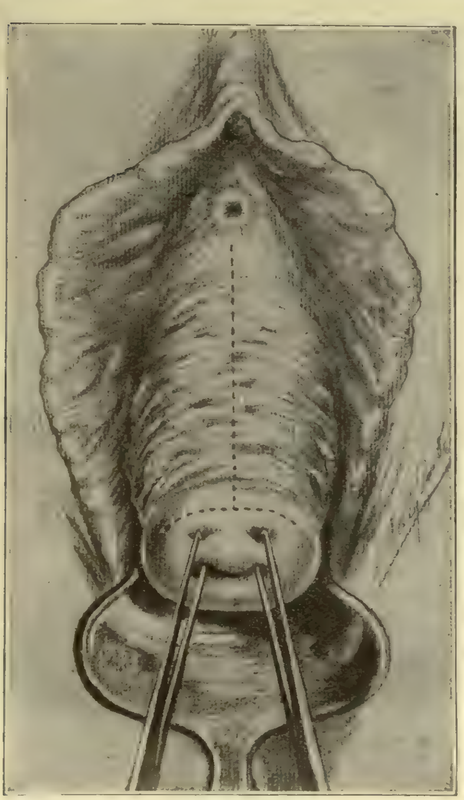

FIG. 208.—Dotted lines show direction of incisions.
(Year-Book Publishers.)

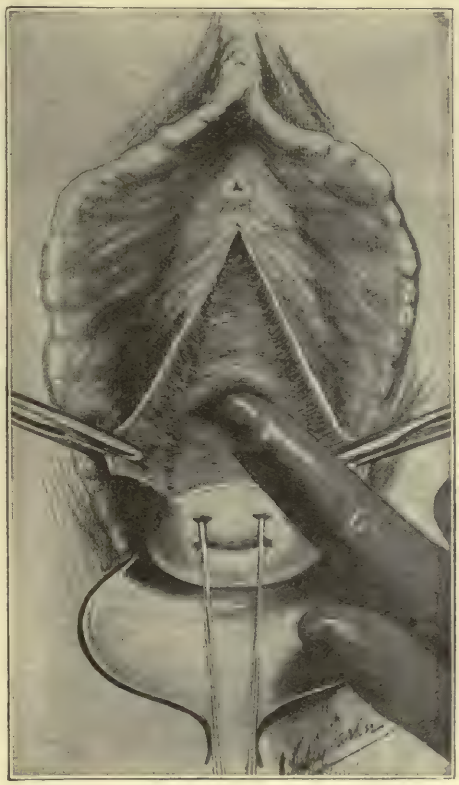

FIG. 209.—Pushing bladder off anterior uterine wall.
(Year-Book Publishers.)

The anterior cervical wall, now bare, is split up the middle line by means of scissors to the extent of permitting the fingers being introduced into the uterus (Fig. 210). The membranes now protrude and if the opening into the uterus is of sufficient extent, these are ruptured, and the child seized by a foot and extracted. Even with a foetus of only twenty weeks there may be a little difficulty with the after-coming head ; if so the head is perforated with a pair of sharp-pointed scissors.

The membranes and placenta are now removed and ergotine injected. An intra-uterine douche of a temperature of 118° F. is then given to stimulate the uterus to retract. If retraction is not satisfactory the uterus should be plugged firmly with gauze. The uterine wound is then stitched, and this is best done with a continuous catgut suture (Fig. 211). The carrying out of this is greatly facilitated by making traction on the ligatures which have been applied to the cervix, for this brings the uterine wound within easy reach and arrests any bleeding. The illustration shows the stitch applied from the outside, but better coaptation is secured by introducing it from the cervical surface. The bladder is now pulled back and tacked into position, and the edges of the vaginal wound united. If it is the pleasure of the operator, a small strip of gauze may be inserted between bladder and cervix to act as a drain. This strip of gauze, and the gauze in the uterus, if that has been inserted, are removed in twenty-four hours.

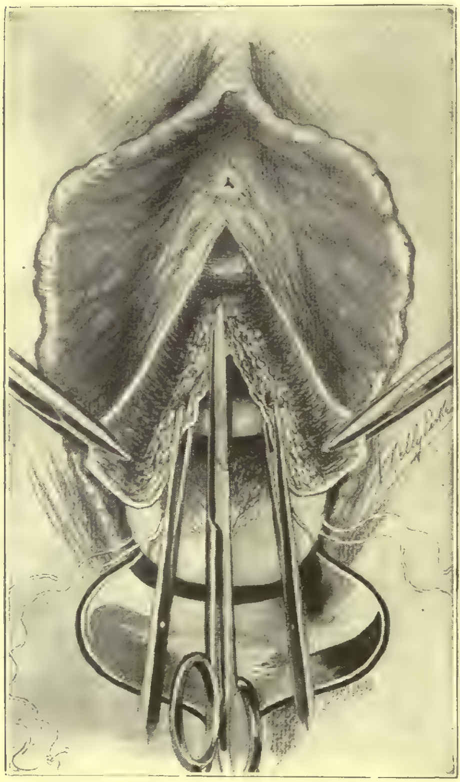

Fig. 210.—Uterus drawn down and anterior wall of uterus incised by means of scissors. (Year-Book Publishers.)

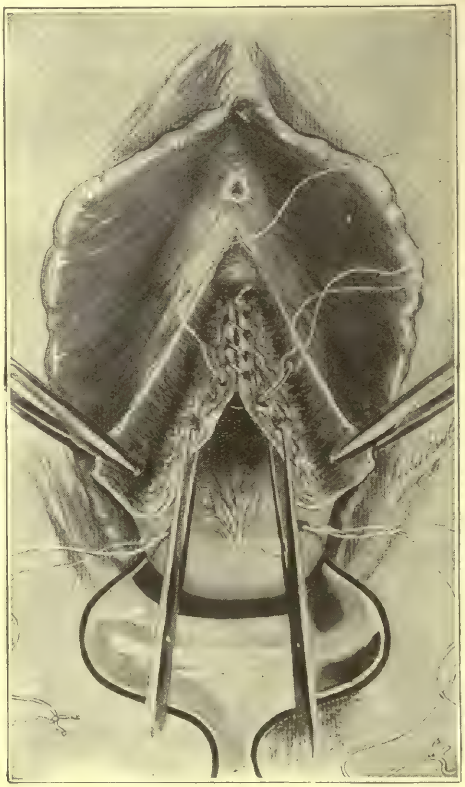

Fig. 211.—Stitching uterus with continuous sutures. (Year-Book Publishers.)

When the operation has to be performed *in the later weeks of pregnancy* more extensive incisions of the cervix are necessary. Bumm has found the splitting of the anterior uterine wall sufficient even in these cases, but Dührssen recommends an incision of the posterior wall also. The latter operator proceeds as follows: The resistance of the lower third of the vagina in the case of a primipara is removed by a right-sided vaginal and perineal incision. If by this incision the levator ani is cut through a large fist can be introduced into the vagina, and the vaginal vault and the vaginal portion of the cervix may be readily brought into view by means of short broad retractors; these arrest by compression any bleeding from the wound. The vaginal portion of the cervix is then seized laterally by two volsellum forceps which are then replaced by two threads, and the posterior lip of the cervix incised as high up as the insertion of the vagina. The posterior vaginal vault is then divided transversely and a retractor pushed through the opening. The peritoneum in the pouch of Douglas is then pushed off the posterior vaginal wall and cervix. In the manner already described the anterior vaginal vault is divided and the bladder pushed out of the way. One has then the whole of the anterior and posterior cervical surfaces laid bare. The anterior and posterior uterine wounds can then be extended. The opening through which the membranes protrude, if they are still intact, must be so large as to allow the easy passage of a large fist. The membranes are then ruptured, a foot seized, and the child extracted. If the uterus is well retracted one may wait until the placenta separates. If the uterus does not retract sufficiently, the placenta must be removed manually and a hot douche given. Should this be insufficient the uterus must be plugged. This is very easily carried out, as the broad retractors can be passed through the opening into the uterus, and between them a large quantity of gauze can be introduced. The anterior and posterior cervical wounds are now carefully stitched as already described and the bladder brought down into position. If the vagino-perineal incision has been made the stitching of it completes the operation. This should be done by stitching the vagina with catgut and the perineum with silkworm-gut sutures.

My experience of vaginal Caesarean section has convinced me that the operation is one of great value and is a most important addition to obstetric surgery. I have therefore no sympathy with those who condemn vaginal Caesarean section; I am convinced that it is an operation which has secured a permanent place in obstetric practice. Without doubt the operation is employed far too frequently in some quarters. This always follows the introduction of any new treatment, but that will soon be righted, and the operation relegated to its proper place.

The conclusion I have come to after considerable experience of vaginal Caesarean section is that up to the twenty-fifth week this operation is the best method for rapidly emptying the uterus. By adopting it shock is lessened, and repeated anaesthesia, so fatal in such cases, is prevented. It has one disadvantage, however, it is not suitable for ordinary domestic practice, for at least two assistants are necessary, one to give the anaesthetic and the other to help the operator. Some have put forward another objection—that the uterine cicatrix may give way at a subsequent parturition, but the results in recorded cases in which there have been subsequent labours give no support to this objection.

In the later weeks of pregnancy when the uterus has to be emptied rapidly, I am convinced that vaginal Caesarean section is not so sound in principle as abdominal Caesarean section.

Although these are my views on the subject I am well aware that a number of obstetricians in America and Germany hold the other opinion that vaginal is preferable to abdominal Caesarean section even in the later months. I know of few, however, in France or Great Britain whose opinions differ in any essential from the views I have expressed. In support of vaginal Caesarean section in the later months of pregnancy the most valuable contribution in recent years is that by Petersen,[1] who in 1911 collected and reviewed 530 cases.

For extraction of the child after incising the cervix, version is the simplest method if the child is very premature. When, however, the foetus is viable and of some size, the choice lies between version and forceps. Most operators prefer version, and I think it is the best procedure if there is no chance of saving the child, for one can perforate the after-coming head and complete the delivery more easily than with forceps. If, however, the child is alive and likely to survive, forceps is indicated, as the foetal mortality is lower than if version is employed.

E. Vaginal Hysterectomy of the Gravid Uterus

The operation of vaginal hysterectomy in pregnancy, parturition, or the puerperium is not much favoured by British gynaecologists; the majority have always preferred and still prefer the abdominal route. But in other countries, more especially in Germany, the operation is frequently employed. Up to the end of the twelfth week of pregnancy the operation can be performed without emptying the uterus, but after the twelfth week the uterus must be emptied prior to its removal. At no stages of pregnancy does the actual removal of the uterus present any special difficulty. Even the full-time uterus, after the child has been extracted, can be readily removed, as Wilson, the writer, and others have shown by the cases they have recorded.

The chief indication for the operation is pregnancy associated with carcinoma of the cervix, but it has also been performed on several occasions for accidental haemorrhage and rupture of uterus. Recently another indication has been introduced more particularly in France and Germany, viz. pulmonary tuberculosis. This, however, is not the place for considering such treatment ; but that it is worthy of consideration is evidenced by the fact that such an eminent and sound obstetrician

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[1] *Trans. Amer. Gyn. Soc.*, 1911, vol. xxxvi. p. 3.

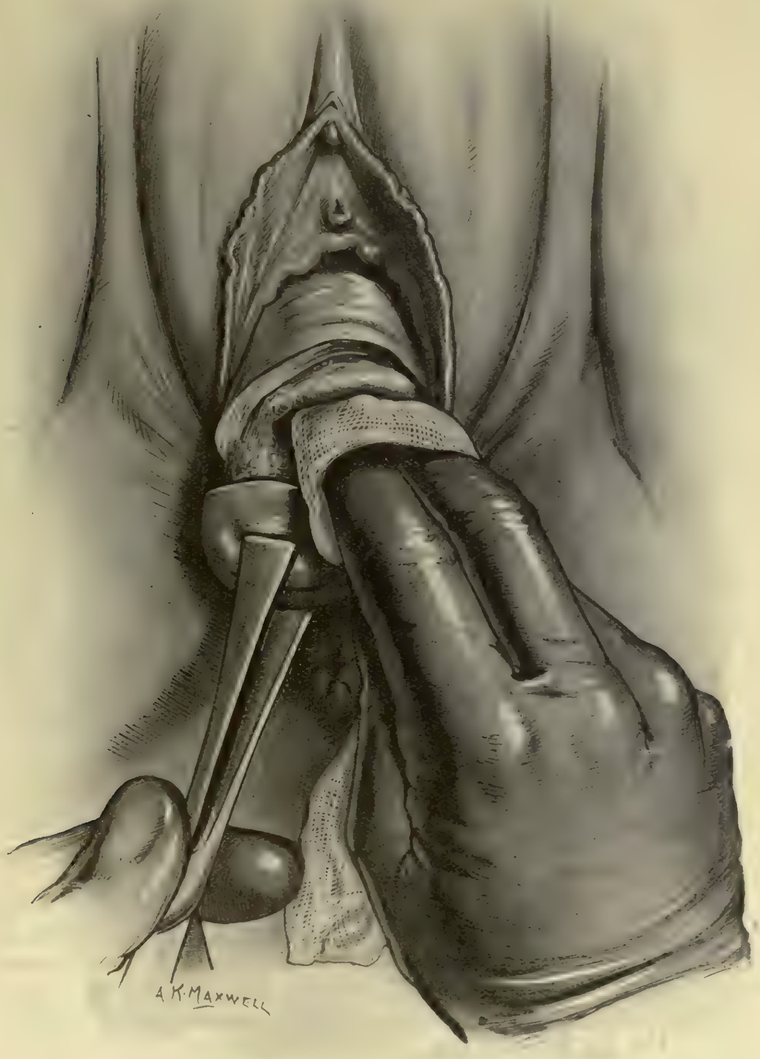

Fig. 212.—Cervix circumcised ; bladder being pushed off anterior wall.

as Bar[1] seriously discusses it in his writings, and has employed it upon three occasions.

It is unnecessary for me to go into any detail with regard to the different methods of performing vaginal hysterectomy as that subject is fully detailed elsewhere.[2] I shall only refer to the method I have found most suitable, and which I have employed in the cases in which I have performed the operation.

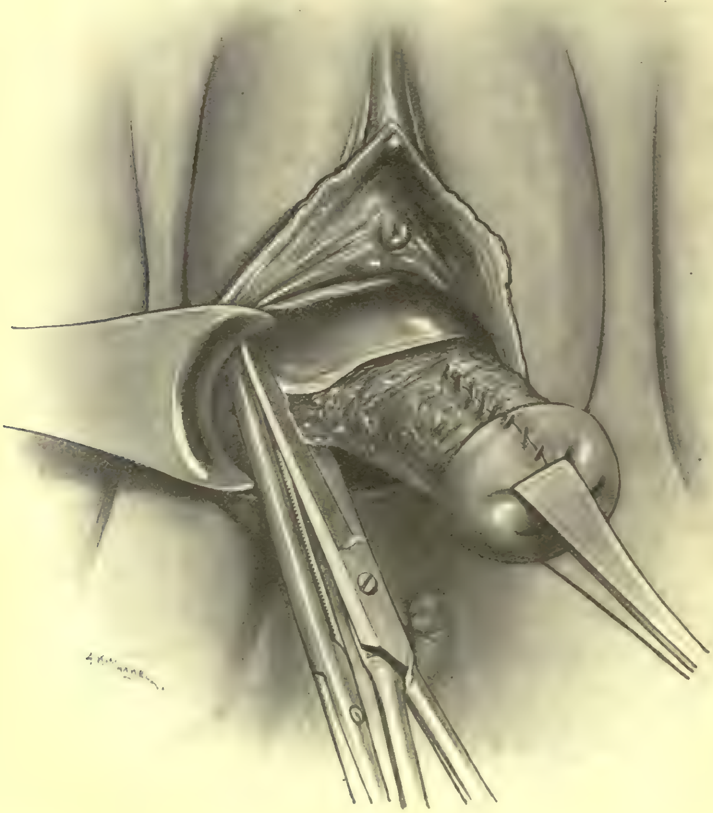

FIG. 213.—Cervix incised to allow removal of anterior contents; incision closed with continuous catgut sutures; lower broad ligament has been clamped and is now being divided by scissors. No haemorrhage occurs from uterus dragged on by volsella forceps.

The patient being placed in the lithotomy position, the field of operation—the vagina and vulva—are very thoroughly cleansed, and if there is any malignant growth it is removed by the knife, or scraped away, and burned with a Pacquelin cautery. The stump of the cervix is then seized with volsellum forceps and pulled down. The lower limit of the bladder is then defined and the vaginal mucous membrane is circumcised just below that level (Fig. 212). The bladder is now pushed off the front of the cervix and the posterior vaginal wall off the back of the cervix. If the uterus is more than two months gravid I incise the anterior uterine wall and remove the ovum. As it is sometimes impossible to reach the utero-vesical pouch until after the lower part of the broad ligaments have been divided I usually open into Douglas's pouch and apply clamps to the lower parts of the broad ligament

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[1] *La Pratique de l'Art des Accouchements*, vol. ii. 3rd edition, p. 35, 1914.

[2] Article on Hysterectomy (p. 459).

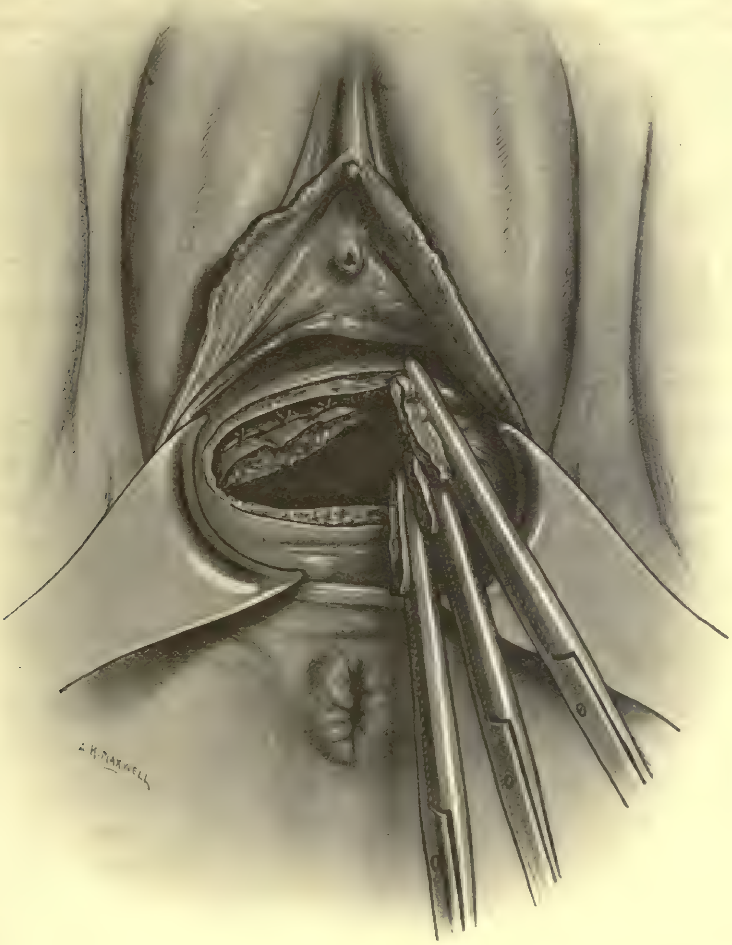

Fig. 214.—Uterus has been removed; right broad ligament is secured by three sutures which have been applied by under-stitching the tissues; left broad ligament still has three clamps applied to it.

close to the cervix, before completely separating the bladder from the uterus. I have found clamps better than ligatures in the first instance. If the uterus is gravid several months it is often difficult to pull down the fundus either through the pouch of Douglas or through the utero-vesical pouch, as is so generally done in performing vaginal hysterectomy in the non-gravid ; I have always therefore applied clamps up each side of the broad ligament and gradually worked my way up until the whole broad ligament was secured. Sometimes this can be done by two clamps on each side but very usually three are necessary (Fig. 213). The uterus is then cut away from its attachments and removed.

It is now in the option of the operator either to leave the clamps attached for forty-eight hours or to under-stitch the tissue secured by the clamps (Fig. 214). Personally my results have been equally good with each of these methods. Should the clamps be left attached, the two or three clamps of each side are fastened loosely together with gauze and a strip of gauze is pushed up between them. (They are removed in forty-eight hours.)

But should ligatures be employed the tissue is pulled down and under-stitched with linen thread, fine silk, or catgut, according to the preference of the operator. The vaginal vault is then closed completely, or a small aperture may be left and a gauze drain inserted, which should be removed in forty-eight hours.

INTESTINAL COMPLICATIONS IN GYNAECOLOGICAL SURGERY

By the late E. W. Scott Carmichael, F.R.C.S.E.
(Edinburgh)

General Considerations.—The gynaecological surgeon is now called upon so frequently to deal with intestinal conditions complicating pelvic surgery, that of necessity he must have as intimate a knowledge of these conditions as of his own special subject.

In considering the possible intestinal complications that may occur, we may consider them from the following points of view: (1) *Intestinal complications resulting from an acute generalized peritonitis of pelvic origin, in which symptoms supervene immediately following an operation.* The nature of these conditions is in most cases a general paretic or paralytic condition of the intestine due to the extension of a generalized inflammation throughout the peritoneal cavity. The condition of the patient becomes a serious one within a few days of operation and calls often for prompt surgical treatment by the gynaecological surgeon. There is no doubt that many lives will be saved, if the gynaecological surgeon has a thorough knowledge of intestinal surgery and can apply this promptly. (2) *Intestinal complications following the more chronic inflammatory conditions in the pelvis, or due to pressure of tumours causing mechanical interference with the intestines.* The symptoms caused thereby are generally due to mechanical causes, and are of the nature of a chronic obstruction, or chronic abdominal pain due to adhesions of the abdominal viscera to one another, or to the abdominal parietes. As a result of these the gynaecological surgeon may be faced with an extensive intestinal resection during the course of any pelvic operation.

1. Intestinal Complications arising from Acute General Peritonitis of Pelvic Origin

In approaching this question, we must consider what are the pelvic causes of generalized peritonitis. It is generally a direct infection from the Fallopian tubes, at first localized in the pouch of Douglas, and gradually extending upwards to the general abdominal cavity. As compared with peritonitis due to other causes, that of pelvic origin is slower in its progress and less virulent in character. Hence it is, that patients are not so frequently at once overwhelmed with an acute toxaemia as in peritonitis the onset of which is higher up in the abdomen; a possible exception may be made in the case of pneumococcal peritonitis, the certainty of the origin of which from the Fallopian tubes is still a matter of opinion.

The organisms most frequently found are the *streptococcus*, the *staphylococcus pyogenes*, the *bacillus coli communis*, and the *pneumococcus*, with very rarely the *gonococcus*. The infection as compared with that of bowel-origin is relatively unmixed, a pure infection being not uncommon.

It is seen as a direct infection spreading from an acute local source after childbirth or abortion, or as an acute condition superadded to a previous chronic infection of the uterus and tubes, due to a sudden leakage or rupture occurring spontaneously, or as the result of operation. It is comparatively infrequently seen after operation for chronic pyosalpinx, which seems at the time of operation to be comparatively sterile and innocuous.

The typical course is seen following such an infection after operation. It is comparatively slow and steady in its onset, and spreads gradually to the upper abdomen, not reaching its greatest intensity till the fifth, sixth, or even the seventh day, thus differing very strikingly from the peritonitis set up by perforation of one of the hollow viscera. A fulminating type is occasionally present, such as is seen in other parts of the abdomen. It is also seen in its mildest forms following the complete abdominal operation for uterine cancer, and is apparently due to a low form of infection. It is in these milder cases of acute peritonitis that intestinal complications occur so frequently. Under these circumstances the onset is to be feared when on the third or fourth day a gradually developing tympanites supervenes, associated with sickness from time to time, but this again may be absent till later in the disease.[1]

The inflammation affects first the lower coils of the ileum, the omentum, and the transverse colon, and may remain practically limited to these. Under these circumstances the patient may recover with the later risks of intestinal adhesions and obstruction. The condition is characterized by a slow toxaemia, the patient becoming slightly poisoned with often no rise in temperature to indicate it, but a gradual emaciation and cachexia. There is generally an associated infection of the abdominal wound, and it is not always easy to decide in the early stages whether the infection is localized to the wound alone, or invades the abdominal cavity. The onset of increasing tympanites is suggestive of the latter.

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[1] This point is also dealt with in the Article on After-Treatment of Gynaecological Operations (p. 705).—Editors.

Can anything be done surgically to relieve such a condition ? It is still a matter of opinion in how far drainage of the peritoneal cavity is of value in these cases. At the same time drainage of the pouch of Douglas, with the approximation of a distended coil of intestine to the abdominal wound for opening at a later date, seems in some cases to be of value. There is no problem more difficult for the surgeon to decide than how far he will benefit his patient by reopening the abdomen in a case of peritonitis. His decision must largely depend upon the obstructive symptoms, and when sickness and vomiting are wearing out the patient's strength his course seems comparatively clear. On the other hand it is not always advisable to wait till these symptoms have become prominent. Enterostomy if it is to be successful ought to be performed as early as the third or fourth day, while the bowel has some power of recuperation.

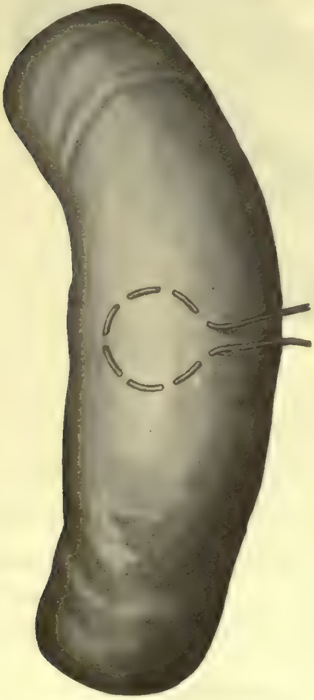

FIG. 215.—Enterotomy.

Coil of small intestine, showing purse-string suture applied prior to opening of bowel by trocar and cannula or by bistoury.

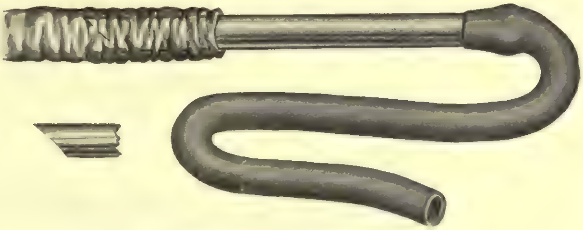

FIG. 216.—Enterotomy.

Glass tube entered into bowel for temporary emptying of small intestine. (After Moynihan.)

The following procedures present themselves as probable means of relief under the conditions above referred to.

Enterotomy.—This is used as a purely temporary measure to empty the bowel of gas and give more space for the operator's manipulations. It is a valuable procedure in colon-distension but can also be used in the case of the small intestine. A simple method of performing this operation is by means of a small trocar and cannula. The coil of bowel is drawn out of the abdominal cavity and well isolated by gauze plugs ; a small area of intestine opposite the mesentery is then selected into which a purse-string suture is introduced, including an area sufficient for the cannula (see Fig. 215). The gas is then emptied from the bowel. After the cannula is withdrawn, the suture is tightened, and covered over by a few interrupted Lembert sutures. This procedure may be repeated in several places. Where the distension is in the small intestine, and especially when widely distributed, some such method as the following may be used : A considerable area of bowel may be emptied by introducing a glass drainage tube as recommended by Moynihan, to which is attached a rubber tube for the escape of the contents. The intestine may be drawn on to the glass tube (Fig. 216), till as much as 8 to 10 feet can be emptied. The bowel may also be washed out through the tube. The opening is closed by two rows of sutures, one extending through the whole thickness of the bowel and the other being a continuous Lembert suture. The exposed loop of intestine is then thoroughly cleansed with warm sterile water or saline solution before it is returned to the abdominal cavity.

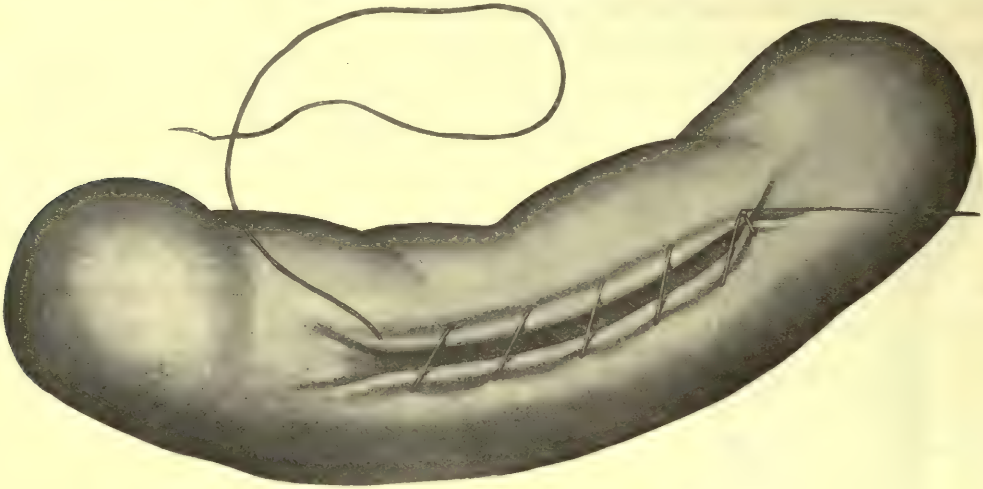

FIG. 217.—Enterotomy. Closure of intestine.

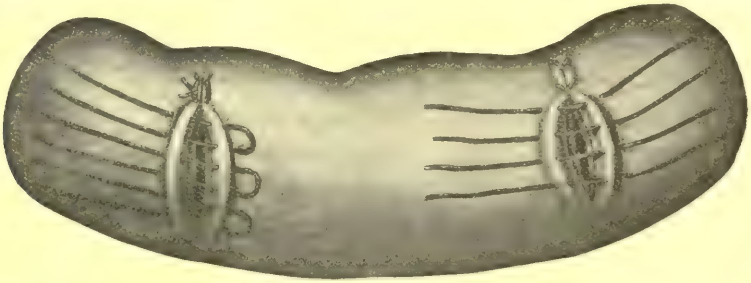

FIG. 218.—Enterotomy. Alternative methods of closure of intestine.

Enterostomy.—It is well to draw attention to this operation as a safety-valve in intestinal obstruction even of paralytic origin as seen in generalized peritonitis. The operation is a simple one, and life-saving when applied early before the bowel has become too distended. To this end it is rarely ever successful after the fourth day.

The wound may be reopened under a local anaesthetic, and the presenting coil of distended intestine is first punctured to remove the collected gas, and the tube then introduced according to the method of Mayo.

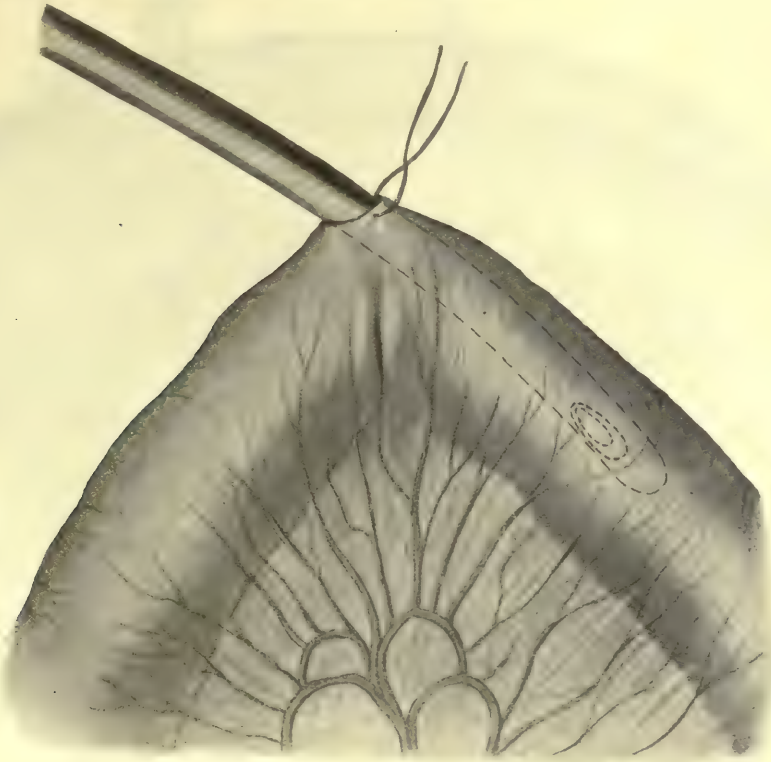

FIG. 219.—Enterostomy. First stage. (After the method of Mayo.)

If the patient survives the introduction of a tube for twenty-four hours, she will probably recover, and the tube may further be used as a channel for nourishment even if in the lower part of the ileum.

The technique of the operation consists in selecting a distended piece of the bowel and making a small incision into its lumen opposite the mesenteric margin. A rubber catheter about the size of No. 8 or No. 9 English, is introduced downwards so as to project 3 to 4 inches into the bowel. This point is then fixed into position by a fine linen thread or chromic gut ligature, and the remaining portion of the catheter is embedded in the intestinal wall, after Witzel's method (Figs. 220 and 221), and finally anchored to the parietes. There is thus no fear of leakage, and liquid feeding may be instituted later if necessary.

Appendicostomy.—Where the paresis of the intestine involves the caecum and lower ileum, this operation has a certain sphere of usefulness, and forms a safety-valve in caecal distension, while at the same time it offers an additional means for stimulating the intestine by means of lavage and the introduction of medicinal substances. An ordinary McBurney's incision is made, and the appendix, having been isolated and freed, is brought out of the centre of the wound or through a small special opening in the fibres of the internal oblique and transversalis muscles. It is secured at its base by a suture to the abdominal wall, taking care not to obstruct the lumen by so doing. It is not necessary to remove the free end of the appendix for some days.

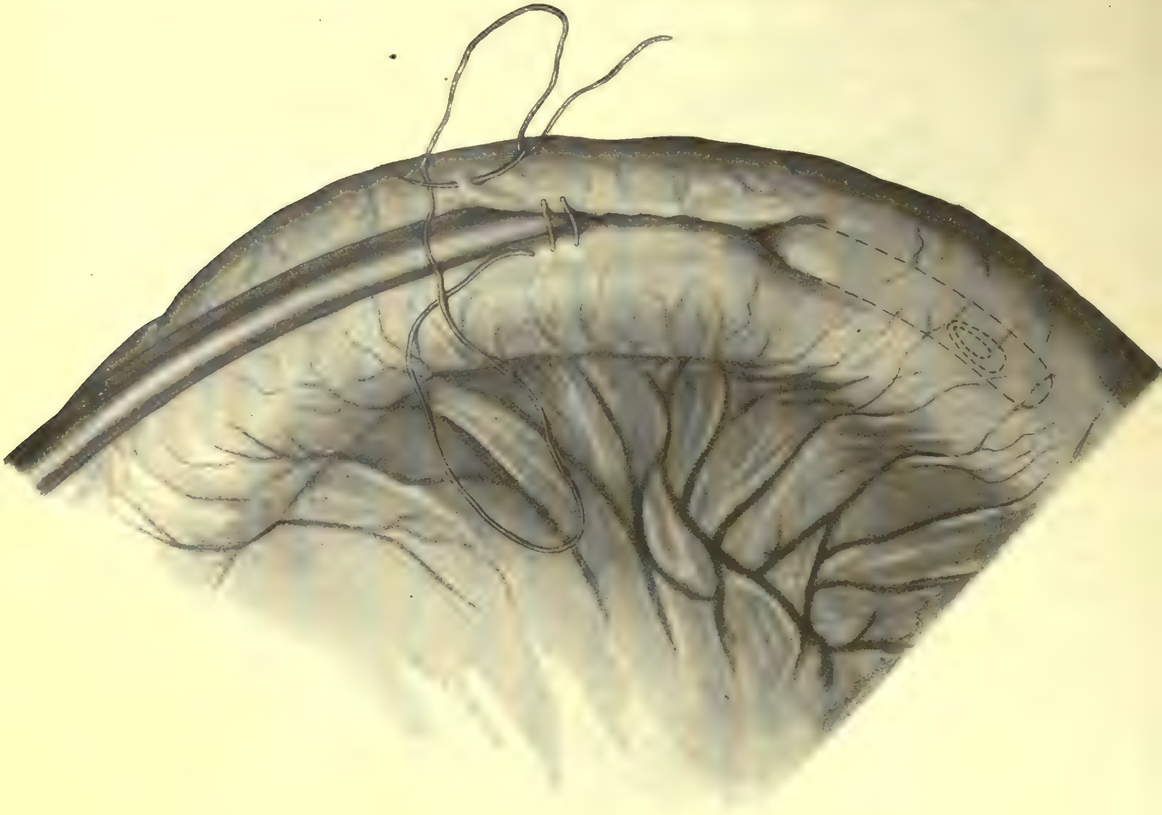

FIG. 220.—Enterostomy. Second stage. (After the method of Mayo.) Note the stitch employed at this stage.

The above methods are those employed for the relief of persistent distension due to paralysis of the intestines of inflammatory origin, and are the last means open to the surgeon for the relief of this troublesome and sometimes fatal complication; it is also necessary to refer briefly to the similar complications which affect the stomach and duodenum, fortunately to a lesser extent, but at the same time no less frequently.

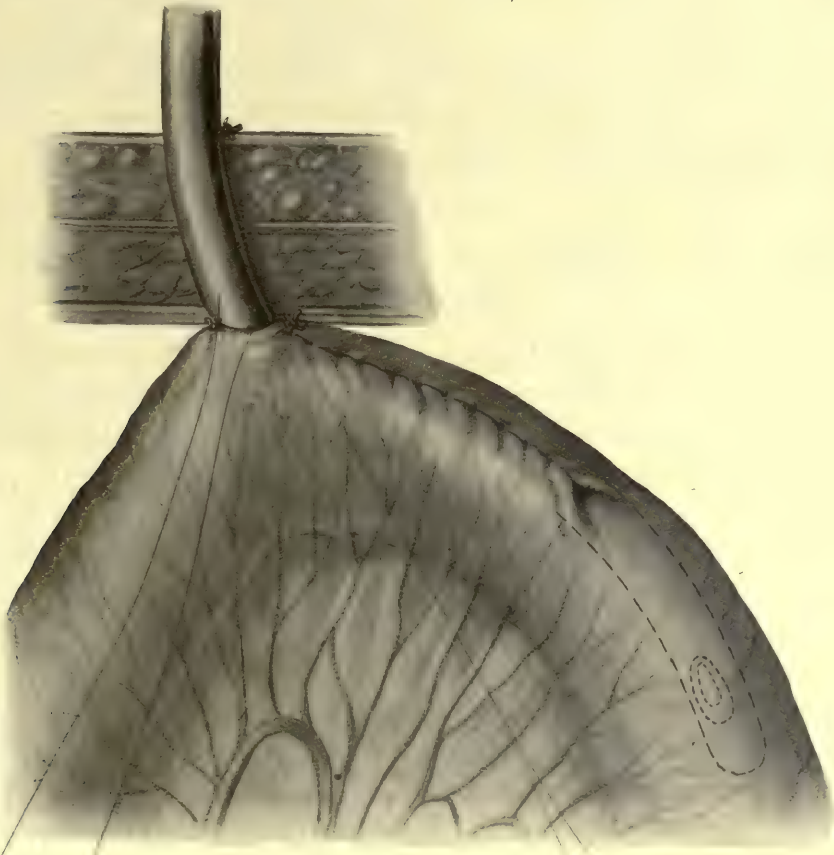

FIG. 221.—Enterostomy. Last stage. (After the method of Mayo.)

Gastric Dilatation, Acute Gastroduodenal Ileus.—This condition in its severest form only occurs occasionally, but in mild forms it is undoubtedly common and is responsible for some of the uncontrollable varieties of chloroform-sickness following operation. The author has seen it in four cases. It may follow operations at any date within the first week, and if unrecognized is almost always fatal.

· Uncontrollable sickness is its chief distinguishing symptoms. An examination of the abdomen reveals a dilated and often splashing stomach.

In all cases of anaesthetic sickness persisting beyond the third day, this condition should be looked for. Its treatment in the early stages is simple. The passage of a stomach tube every four hours and the washing out of the stomach, will usually relieve the condition after twenty-four hours. It is surprising how often in an abdominal case which is not progressing favourably, the passage of the stomach tube reveals this condition and is a source of immediate relief.

This treatment should be associated with turning of the patient on to her side, or prone on the abdomen, so as to prevent congestion of the superior mesenteric artery. This procedure is second only in importance to the washing out of the stomach. It is only in the most advanced cases that such procedures as gastrostomy, and gastro-enterostomy are necessary.

2. Injuries of the Intestines due to Adhesions and old Inflammatory Conditions of the Bowel

It must be remembered that this is always a serious complication of any abdominal condition. It has been stated that in nearly 80 per cent of cases of intestinal adhesions, signs and symptoms are present. It therefore behoves the gynaecologist to perform his operations in such a way as to reduce to a minimum the possibility of post-operative adhesions. It is a point which is often overlooked in carrying out the complete and detailed toilet of the peritoneum, and there is none more at fault in this respect than the busy and so-called ‘brilliant’ surgeon, who cannot afford to spend time on the small details.

Actual operative interference is responsible in some cases for subsequent intestinal complications, from the adhesions of bowel or omentum to lines of suture or raw surfaces unprotected by peritoneum. Thus the surgeon’s responsibility is a great one; he must eliminate this danger as much as possible. The shutting off of a uterine or vaginal stump, and the closure of the abdominal cavity, cannot be carried out with too much attention to detail.

The commonest and most serious complications are found associated with pelvic inflammatory affections, and they involve those portions of the intestinal tract which lie normally within the pelvis, or just above its brim and in contact with the inflamed pelvic structures—that is to say, the rectum, the lower part of the pelvic colon, and the ileum, which naturally drops into the posterior pelvis or lies like a lid on the top of it. To a lesser extent the vermiform appendix, the caecum, and the transverse colon may be involved.

Probably the most common segment of the entire intestinal tract to be involved is the last 6 inches of the ileum, which normally lies in the pelvis and is therefore more likely to be infected. It has a short mesentery and is not so easy to repair as other portions of the large and small intestines. When large tumours invade the upper part of the abdominal cavity, such as ovarian cysts, fibromyomata, dermoids, especially those with twisted pedicles or those which suppurate, adhesions may take place higher up to the intestines, to the transverse colon, and even to the stomach and liver. Thus the area covered by adhesions may be a very wide one. In cancer of the ovary or tuberculosis of the Fallopian tubes, adhesions between adjacent coils of intestine are common, and unfortunately rarely admit of any operative treatment.

A common form of intestinal adhesions is a general agglutination of the coils of the intestine amongst themselves following a peritonitis which has passed away. When the abdomen is opened the separate loops are often difficult to distinguish, but in their place is seen a flattish red sac simulating a collapsed tumour, and to all appearance with its surface covered over by numerous slight irregularities and streaks, but on careful observation a vermicular wave can be observed, thus proving the presence of small intestine. These adhesions are often loose and may be easily separated, but their great extent prohibits this.

Such a condition may be present without any displacement of intestine, and without the patient suffering in any way from abdominal symptoms indicating obstruction ; and therefore operative interference is rarely necessary. An unwise operation may lead to fresh raw surfaces being formed by which the intestines may become fixed in abnormal positions. As a rule extensive separation of adhesions ought not to be attempted unless there are symptoms of internal cramps or obstruction.

The following are the chief kinds of intestinal complications resulting from adhesions which may be either flat, or velamentous, or in the form of peritoneal bands.

(1) Intestinal stricture.

(2) Anastomosis between loops of bowel leading to fistula.

(3) Anastomosis between loops of bowel and the bladder, uterus, or Fallopian tubes.

Adhesions are apt to be found following more or less generalized peritonitis, when the interval between the attack and the operation is a short one. At a later date these adhesions disappear spontaneously. This fact is frequently demonstrated after operations for appendicitis associated with suppurative peritonitis. A second operation, perhaps for the cure of a ventral hernia, reveals the complete disappearance of the adhesions. Even in tuberculous conditions adhesions may disappear to a surprising extent.

In inflammatory conditions of the Fallopian tubes, the disease is at first limited to the mucous membrane of the tube but tends to spread through its wall, setting up perisalpingitis. One attack of this kind may be recovered from completely, but repeated attacks lead to more permanent adhesions between the tubes and the neighbouring organs. The author has seen on the operation-table the Fallopian tubes adherent and glued together as part of a pelvic peritonitis, a condition which would seem to prohibit any chance of conception, and yet the patient later has borne a child. It is probable that in these cases the adhesions have become completely absorbed.

Thus when the inflammation is acute, and adhesions are recent, it is better not to interfere with them, as Nature will bring about a more certain cure than any mechanical interference. It is a good policy only to interfere with adhesions when they cause symptoms. The separation of adhesions always leads to the formation of raw surfaces which will readhere and give rise to still more dense attachments.

In old-standing cases the intestines are so agglutinated that they form a roof over the true pelvis, completely excluding the pelvic viscera from the rest of the abdominal cavity and often retaining a local collection of fluid within the pelvis. It is in these cases that obstructive symptoms are apt to supervene. Sometimes the adhesions are loose and velamentous, forming veils or bands across the abdominal cavity; around such structures coils of intestine may become nipped or kinked. They are often seen in the right iliac fossa, and not infrequently with the appendix vermiformis as the point of origin.

These adhesions often mark the site of a previous abscess which has become absorbed or has burst into the bowel; occasionally a spontaneous anastomosis of bowel may occur in this way.

Actual stricture of the intestine may occur from internal ulceration, or from actual pressure on, or extension to, the bowel from inflammation of the pelvic connective tissues; this is seen sometimes in the case of the rectum (periproctitis).

Methods of dealing with Adherent Intestines.—This question is of the greatest importance to the gynaecological surgeon, and it requires considerable skill and experience on the part of the operator, especially to avoid the risk of infection of the general peritoneal cavity. It should be the endeavour of the surgeon to avoid injuring the wall of the intestine as far as possible. This can be done by the judicious use of scissors or the scalpel, instead of tearing asunder one piece of bowel from another. Slight, superficial, and velamentous adhesions can be severed by means of scissors, and even at the risk of cutting the lumen of the bowel it is better to continue cutting, rather than by forcibly tearing to risk stripping off pieces of peritoneum and thereby leaving a long raw surface, which is difficult to cover over. An adhesion between the uterus and rectum can be got rid of by pushing the uterus forward and the rectum backwards ; the adhesions are then put on the stretch and may be divided by means of the scissors.

When the adhesions are very dense and cannot be stripped off in this fashion, it is better to dissect off a small thin shell of the uterine wall, or of the tube or ovary as the case may be, and leave it attached to the intestine. This is especially advisable when the bowel is adherent to a myoma or to an ovarian cyst.

The leaving of small portions of tumour-capsule attached to the intestine, rather than attempting to dissect them from off the bowel, is a procedure of considerable value, and may be a means of saving life in cases where the adhesions are dense and very extensive. Under certain circumstances such as in papillomata or malignant adenomata of the ovary such a procedure is inadmissible. Similarly when the intestine is adherent to the dense and thickened walls of an old abscess-cavity, a considerable piece of the wall may be excised, and left adherent to the intestine.

When the adhesions are very dense and extensive, the only course left to the surgeon is to leave them alone, and to perform some form of anastomosis by joining the ileum or even the jejunum to some part of the colon. Such operations are often attended with a large measure of success, provided the anastomosis is carried out without tension on the anastomosing loops.

In cases where the adhesions are largely localized to the right iliac fossa, it may be impossible for the surgeon to say whether or not the vermiform appendix is at fault ; therefore it should be removed in all such cases. It is a safe rule that whenever this organ is incorporated in adhesions, it ought to be removed. In some cases where the caecum and ascending colon are extensively involved, a complete removal of this segment of bowel together with its lymphatic area is indicated ; this involves the anastomosis of the ileum to the transverse colon.

The following are the injuries that may be met with under the above conditions :

1. *Stripping of the Peritoneal Coat.*—This is a troublesome and unfortunate accident. It may occur in the long axis of the bowel, or it may encircle the whole circumference of the intestine. The approximation of the edges of such a raw surface necessitates interference to a greater or less extent with the lumen of the gut. In the former case the bowel will tend to be constricted longitudinally and in the latter it will lead to a bunching up of the mucous membrane within the bowel. It is surprising, however, to what an extent the bowel will accommodate itself to considerable constriction, and this method of simple approximation of the raw edges

of a fresh ulcer is the most satisfactory method of dealing with the condition, when feasible. Use should be made of strips of omentum or even pieces of mesentery turned up from below to cover in these raw defects, but the latter can only be used to a limited extent. The use of sterilized oil or vaseline has not in the author's experience afforded such a preventive to the re-formation of adhesions as some authorities would claim for it.

Where extensive stripping of peritoneum is limited to a particular segment of intestine, resection of the affected portion of bowel and end-to-end anastomosis is the best treatment.

2. *Stripping of the Peritoneum with, in addition, an Opening into the Lumen of the Bowel.*—The surgeon cannot be too careful, when peritoneal stripping is extensive, to make sure that a communication with the bowel is not present. This is often a very small one, with ragged edges forming a valvular opening which may escape notice. It may often be detected by the presence of a little frothy mucus upon the raw surface. The treatment consists in the closure of the opening by a through-and-through suture, and the restoration of the peritoneum by Lembert sutures.

Natural cure may take place by the adhesion of the margins of the opening to a neighbouring coil of intestine, and in some cases this may result in the formation of an internal fistula between the two loops of bowel.

3. *An organic stricture of the bowel* may result from external pressure or from secondary ulceration and constriction of the lumen of the bowel. Under these circumstances the only treatment consists in the resection of the strictured bowel and an end-to-end anastomosis ; or something of the nature of a short circuit by means of a lateral anastomosis. Intestinal obstruction due to gynaecological disease is usually caused by multiple adhesions of intestine giving rise to kinks and folds : the onset of symptoms is slow, for complete blockage of sudden onset is not so common as a gradual incomplete obstruction. Widespread adhesions with multiple kinks form a condition which lends itself rather to methods of short circuit by lateral anastomosis than to extensive resection of bowel.

An intelligent and judicious use of this means of relief has saved many lives which would otherwise have been sacrificed. On the other hand many lives have been lost by the gynaecologist not appreciating this fact, or not being competent to apply the principles of intestinal surgery.

Mayo has pointed out that the need for resection of intestine in intestinal obstruction, depends rather on the damage to the blood supply of a portion of bowel than on a blocking of the intestinal lumen. Therefore, in considering this question, the extent of vascular involvement must be considered, along with the degree of infection, and the amount and toxicity of the intestinal contents. The upper part of the intestinal tract is comparatively free from pathogenic bacteria. Their number and virulence gradually increase towards the lower end of the ileum where they are in great numbers. The walls of healthy intestine are very vascular and competent to deal with and prevent the penetration of micro-organisms. But if the faecal current is obstructed the resulting distension of the bowel impedes the blood supply, and the contents becoming infected, bacteria then pass through the walls and infect the general peritoneal cavity, and general septic peritonitis soon supervenes. The intestine above the seat of obstruction becomes filled with poisonous products, which are toxic as well as infectious.

The mortality of resection for intestinal obstruction has decreased considerably since surgeons have recognized the necessity of emptying the bowel above the obstruction by means of a temporary opening to drain its contents, before doing a subsequent resection.

These points should be appreciated by gynaecologists as they involve a principle the observance of which has done a great deal to improve the technique and the results of intestinal surgery.

In searching for any seat of intestinal obstruction it is wise to begin in the ileo-caecal region and endeavour to find collapsed bowel, tracing it upwards to the seat of obstruction, rather than to turn out numerous coils of distended intestine and trace them downwards. This also is a principle which has an important bearing upon the question of shock to the patient and direct injury to the distended bowel.

General Considerations on Resection of the Intestine

Resection of the Small Intestine.—In cases where resection is required for intestinal obstruction the form of operation chosen depends to a certain extent on whether the condition is acute or chronic.

In acute conditions, speaking generally, it is better to perform end-closure of both cut extremities of bowel by a two-row suture method, and re-unite the bowel by lateral anastomosis. The purpose of this procedure is to keep the junction away from the dangerous mesenteric border with its blood-vessels, and to make the anastomosis at a point where there is adequate peritoneum and the tissues are healthy. The non-toxic fluid contents of the small intestines add much to the safety of such a procedure. The cut end of the intestine is crushed with a heavy clamp, and the groove thereby formed is tied with catgut, the blind end being inverted like the stump of a vermiform appendix and closed with a linen-thread purse-string suture

(Fig. 228). In removing the resected bowel, more should be removed on the side opposite the mesenteric border so that there shall be no question as to the vitality of the part. The lateral anastomotic opening should not be less than 3 inches in length. It will therefore be noted that while theoretically it may be better to anastomose bowel end to end, so that the intestinal peristalsis may be continuous, practically, the above reasons overweigh this in favour of end-closure and a lateral anastomosis. The danger of intussusception of the proximal blind end can be avoided by leaving it short and attaching its stump to the walls of the distal intestine.

While lateral anastomosis is the operation of choice in cases of acute obstruction, end-to-end union is to be preferred in cases of chronic obstruction, and this should be specially noted by the operating gynaecologist. The immediate functional results are better after end-to-end suture than after lateral anastomosis. It has been shown experimentally (Cannon) that there is delay in the passage of the contents through the opening in a lateral anastomosis and that this is not the case in end-to-end unions. In process of time, however, a lateral union adapts itself to circumstances, so that the faecal current becomes direct, and a slight elbow-angle in the intestine is all that marks the site of junction.

Resection of the Ileo-Caecal Angle and Ascending Colon.—The ileo-caecal region offers a favourite site for operative interference. It must be remembered that in this region the ultimate branches of the superior mesenteric artery are terminal, and are not arranged as they are higher up in the small intestine, where the main blood supply is continuous to the bowel below. The contents of the bowel in the ileum are still fluid, so that there is not the risk, as in the large intestine, that solid faecal masses may endanger the security of the suture-line. The arrangement of the lymphatics of the colon is specially favourable for resection, in that the glands are not numerous and are not so readily infected as are those of the small intestine. It has been shown that glandular metastasis in malignant disease of the colon is comparatively late in its occurrence, and that a patient may die of intestinal obstruction, before the glands become secondarily affected.

It may be taken as an established rule that ileo-caecal resection also necessitates removal of the ascending colon, and *vice versa* that removal of the ascending colon should include the caecum. Ileo-colic anastomosis is so satisfactory that it entirely compensates for a somewhat extensive removal of the bowel. Ileo-colic anastomosis should always be by lateral union, the lower part of the ileum being united to the transverse colon near the hepatic flexure and under cover of the great omentum. The method adopted is similar to that in the case of the small intestine, namely by crushing and inverting the proximal and distal cut-ends and uniting the bowel by two rows of suture.

Resection of the Transverse Colon.—In the resection of this part of the intestine it is well to remember that its blood-supply is furnished by one vessel alone, namely the middle colic artery, which must be carefully preserved, otherwise the whole transverse colon is in danger of sloughing. The contents of the transverse colon are still semi-fluid. End-to-end anastomosis is most satisfactory unless there is a disproportion in size of the proximal and distal segments due to hypertrophy of the former, when a lateral anastomosis is equally efficacious.

Resection of the Splenic Flexure, Descending and Pelvic Colon.—Here the contents of the bowel have become more or less solid, especially in the pelvic colon which is the true faecal reservoir. The descending colon is almost invariably empty, only acting as a connecting link between the transverse and the pelvic portions. Owing to the solid character of the faeces, resection in this region as a general rule ought to be performed in two stages.

The cause of the obstruction is usually malignant disease or some chronic inflammatory condition originating in the bowel, or spreading to it from without.

A complete primary resection in cases of obstruction here is often fatal, and this should be borne in mind by the gynaecologist. It is better to follow the method first recommended by Mikulicz, namely to draw out the affected loop of intestine above the stricture and fix it to the abdominal wall, and to relieve the obstruction by opening this on a subsequent date, according to the condition of the patient. Still later resection may then be made and the fistula closed by crushing clamps.

After-Treatment.—It only remains in a few words to refer to the after-treatment of cases of intestinal resection. The patient should be placed preferably in the semi-sitting posture immediately after operation, so as to avoid as far as possible the tendency of any sepsis to spread upwards.

Rectal salines are almost a necessity especially in resection of the small intestines, four to six quarts being introduced within twenty-four hours. Washing out of the stomach is of considerable importance if there is repeated nausea or a tendency to prolonged vomiting.

OPERATIVE METHODS

Surgical Anatomy.—The large intestine, it will be remembered, is about 5 to 6 feet in length, and is for the most part freely mobile. The transverse colon is frequently in contact with the female pelvic viscera, and hence is under the observation of the gynaecological surgeon. The caecum and vermiform appendix are, as a rule, freely invested with peritoneum, and hence are freely mobile. They often lie entirely in the true pelvis, and it can therefore be understood that inflammatory conditions of this portion of the intestine, from their proximity to the Fallopian tubes and uterus, must give rise to conflicting symptoms.

The ascending, descending, and iliac portions of the pelvic colon as a rule have no mesentery, and are firmly applied to the postero-lateral wall of the abdomen. It will be appreciated therefore that any operative interference must necessarily involve a mobilization of these structures to permit of free handling and manipulation. The last 8 inches of the ileum also lies in the pelvis and ascends to join the caecum. It is often tacked down to the bottom of the pouch of Douglas by a fold of peritoneum which by its traction may give rise to painful symptoms (Lane's kink). It has the same blood supply and lymph drainage as the caecum, by means of the ileo-caecal vessels. For this reason in all cases of malignant disease of the caecum, the appendix and the terminal 6 inches of the ileum must be removed.

The ascending colon is supplied by the right colic artery, which anastomoses with the ileo-colic below and the middle colic above (Fig. 223). In carcinoma of the ascending colon also, it is therefore necessary to remove the caecum and the terminal 6 inches of the ileum in order to include the area of lymph drainage. The lymphatic drainage becomes less free after the transverse colon is passed. It can be understood therefore that the possibility of metastasis tends to diminish to some extent, in the descending and pelvic colon, a fact which clinical experience would seem to bear out.

The entire large intestine is covered with a greater or less number of appendices epiploicae, which in fat subjects may reach considerable size. As a result of injury or local peritonitis they may become attached to each other, forming kinks of the intestine, or they may become attached to the parietal peritoneum, causing bands which may lead to intestinal obstruction.

The contents of the stomach and duodenum have been shown by Adami and Cushing to be relatively sterile, while in the lower ileum and colon the contents teem with bacteria and micro-organisms of all kinds. This is shown clinically by the fact that gunshot wounds of the stomach and duodenum show a much smaller mortality than those of the ileum and colon. It is therefore advisable before any operation on the intestine thoroughly to empty the lower-bowel contents and get rid of the active bacteria as far as possible.

In obstruction, whether of paralytic origin or due to mechanical causes, it should be the object of the surgeon to relieve it as early as possible. The more distended the intestine becomes, the greater is its vitality diminished and the greater the risk of septic infection. If there is evidence of regurgitation of intestinal contents into the stomach, this should be washed out.

The Operation.—*Incision* should always be made internal to the seat of the disease. If the diagnosis is uncertain, it is best to make a median incision for purposes of exploration, a second incision being made afterwards if necessary. If the proximal portion of the intestine is greatly distended, it is well to make a temporary opening,

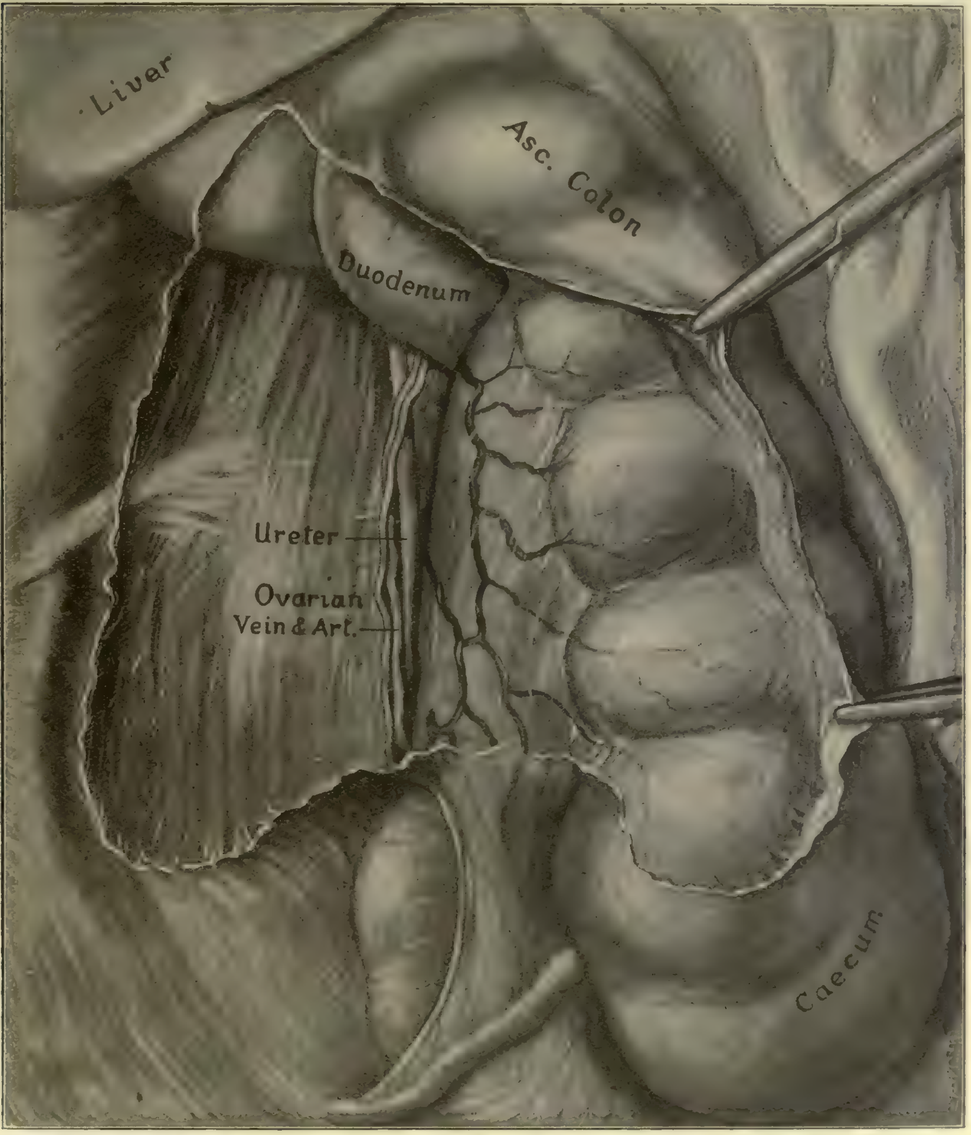

Fig. 222.—Resection of caecum and ascending colon.
Mobilization by dividing outer leaf of mesentery and parietal peritoneum. (After Mayo.)

if the bowel can be drawn out of the abdomen, and empty the loaded coil by means of a tube. This procedure undoubtedly reduces the mortality by 50 per cent in cases of acute obstruction.

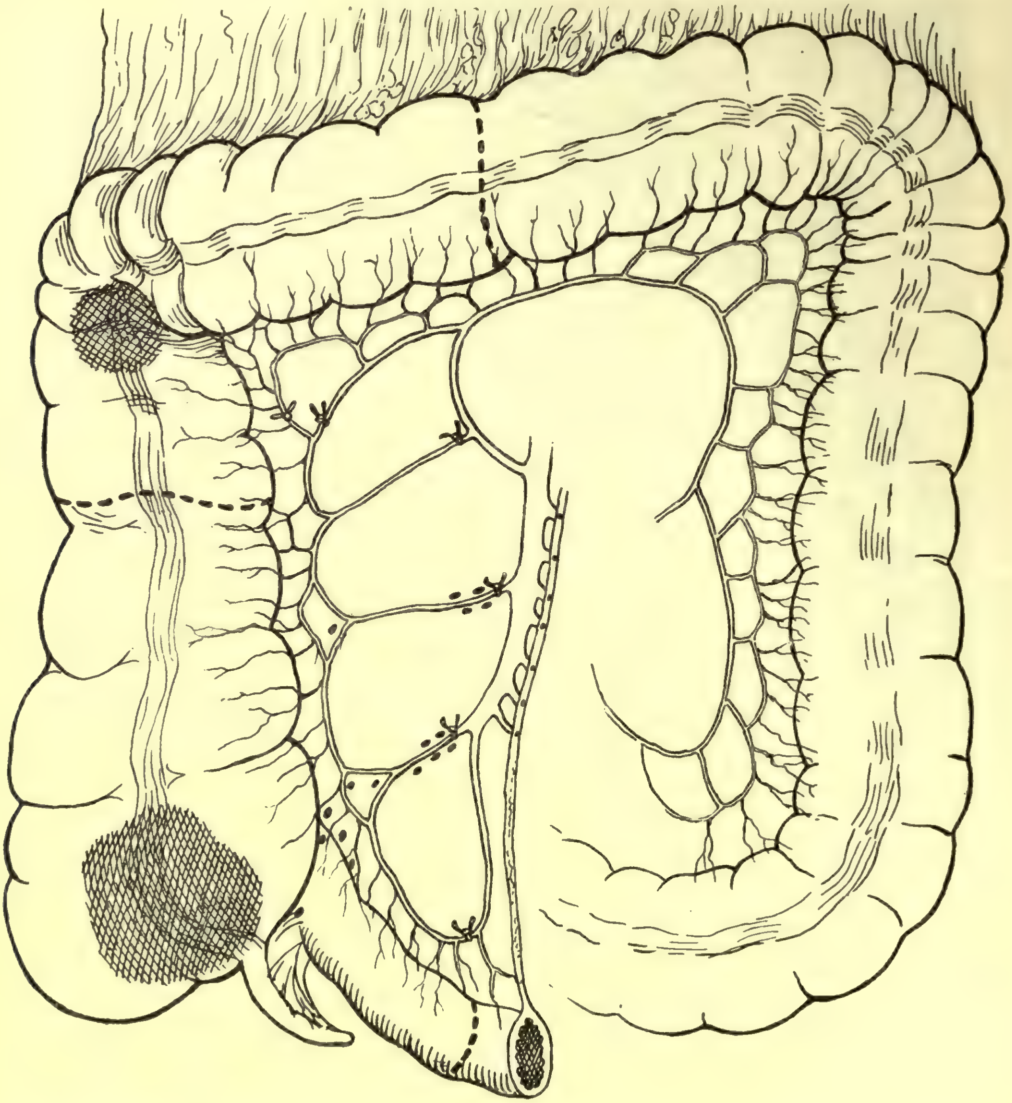

FIG. 223.—Resection of caecum and ascending colon. Showing extent of bowel to be removed in order adequately to extirpate malignant disease.

Ligatures are placed upon the vessels which are to be divided.

(After Jamieson and Dobson.)

The next most important point in the technique of resection is the thorough mobilization of the intestine for purposes of manipulation. The large intestine has a very long mesentery except in the case of the ascending and descending colon, where it is necessary to divide the outer leaf of the peritoneal attachment; this can be done with impunity, as it contains no structure of importance (Fig. 222). The colon can thus be lifted from its bed and swung on its inner leaf towards the middle line.

In separating the colon in the region of the hepatic flexure care must be taken to avoid injuring the duodenum. It is apt, unless care is exercised, to be nipped by the forceps whilst clamping the right or middle colic arteries. Further, the ureters should be identified, as they are adherent to the peritoneum about the brim of the pelvis and may be divided along with this structure. This is especially so in the case of the left ureter.

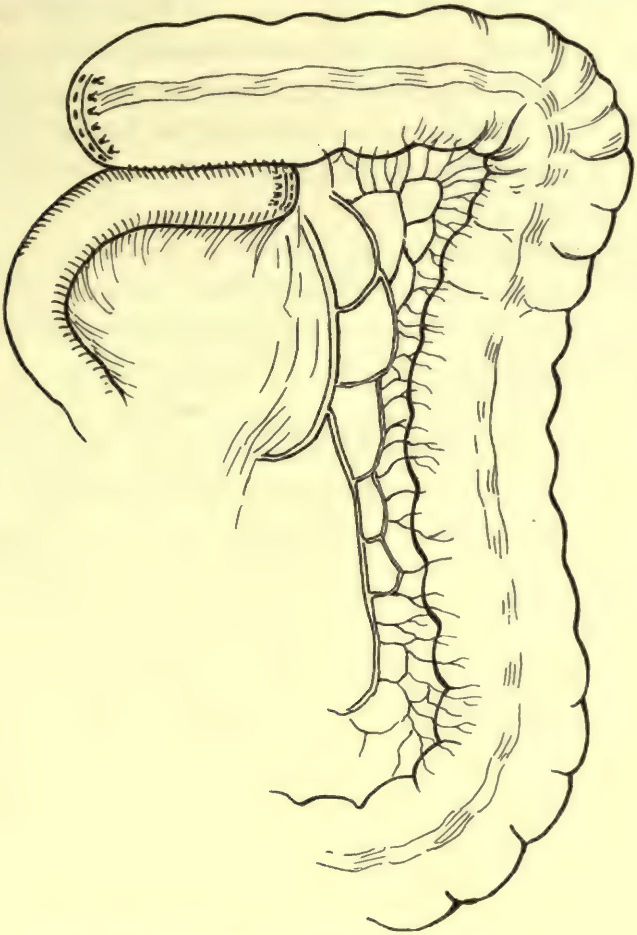

FIG. 224.—Resection of caecum and ascending colon. Anastomosis of ileum to transverse colon.

Thus to perform an efficient operation, it is necessary first to localize the lesion and secondly to divide the peritoneal reflexion to the abdominal wall in order to mobilize the bowel, and permit of its being drawn out of the abdominal cavity, where it can be duly protected by aseptic dressings before resection.

The mobilization of the pelvic colon is effected by incisions along the broad ligament below the ovaries and tubes, and across the bottom of the pouch of Douglas. Any viscus may become adherent to a growth or inflammatory mass in the colon, but this does not necessarily contra-indicate resection of the bowel. Thus not infrequently the ovaries, Fallopian tubes, and uterus become attached to the pelvic colon, and it adds very little to the difficulties of an operation if these attached organs are removed from before backwards in one mass along with the original disease.

Method of Anastomosis.—Practical experience seems to show that there is comparatively little difference as regards the method used in anastomosis as long as the opening is made large enough. Although end-to-end union may be ideal, the results of the lateral operations have been just as satisfactory functionally. Ileo-colostomy is a safe operation, because the contents of the ileum are fluid compared with the solid or semi-solid character of the colon-contents. In joining the small to the large intestine it is probably better to make the lateral operation by suture, leaving as small a pouch as possible beyond the opening (Fig. 224). It may be made iso- or anti-peristaltic without influencing the progress of the intestinal contents, the all-important point being the prevention of angulation.

In lateral union, on the other hand, between parts of the large intestine, the resection should be iso-peristaltic, and the openings brought close to the stump ends, so as not to leave a distal pouch.

In end-to-end suture of the large intestine, it is necessary for the safety of the anastomosis that the site of union should be well surrounded by peritoneum.

When there is marked obstruction from a malignant growth, some surgeons advise a three-stage operation. (1) The affected bowel with the corresponding mesentery and glands is well mobilized and drawn out of the wound and the proximal and distal ends of the loop united by sutures. (2) The first incision is then closed and the part to be excised is brought through a second incision just sufficient in size to carry it easily and hold it in position. The peritoneum is united by a few interrupted sutures to the two limbs of the intestine on its inner aspect. If the symptoms of obstruction are severe, a small incision is at once made in the exposed bowel proximal to the obstruction, and a rubber tube introduced by means of which the intestinal contents are carried into a receptacle. (3) The tumour is cut away on the third to the fifth day, and a heavy clamp applied to the spur about the twelfth day, which as a rule bites its way through in six days.

This operation does not permit of such a careful dissection of the glands and lymphatic area, and the convalescence is slow, the patient being exposed to the unpleasantness of an external faecal discharge for some days, with a possibility of a further operation for faecal fistula.

In making an anastomosis there is always the risk of leakage from a bowel-union, and it is well to drain the area of union by means of a rubber tube.

In low-lying growths of the pelvic colon a combined abdominal and perineal operation may be necessary. If after such an operation direct union of the rectum and pelvic colon is possible, it is safer to pass a rubber tube with an oblique end and a lateral eye above the site of union, to be left *in situ* for ten days, in order to carry off the gas and faeces and save the strain upon the suture-line.

In low-lying carcinomata in the female, when the patient is much reduced from bleeding and sepsis, the Quénu-Tuttle perineal resection of the entire rectum and lower pelvic colon is satisfactory.

Colotomy and Colostomy

These operations are so frequently necessary to the gynaecological surgeon that his experience of them ought to be equal to that of any abdominal surgeon.

Colotomy.—Simple incision of the colon may be performed for temporary relief during the course of an operation, to give the surgeon more room for manipulation. It is indicated in any case of distension of the colon. The two following cases occurred in the practice of the author and serve to illustrate its necessity:

1. A female patient, aet. 35, with symptoms of increasing intestinal obstructions of five days' duration complicating pregnancy at the sixth month, was found to have an enormously distended colon extending as far as the pelvic portion. The distended colon obscured even the pregnant uterus. A trocar and cannula was inserted into it at both ends of the transverse colon through the longitudinal band. The bowel collapsed completely, and subsequent manipulation was then possible.

The obstruction was due to the long pedicle of an ovarian dermoid becoming wrapped around a long pelvic meso-colon. A loop of pelvic colon was completely strangulated and in imminent danger of becoming gangrenous. On its release the bowel recovered and the abdomen was closed without drainage, the patient making an uninterrupted recovery. This case illustrated the very great importance of not trying to manipulate distended intestines, and the futility of trying to find any cause of obstruction without emptying the distended bowel.

2. The second case was that of a lady, aet. 38, who developed appendicitis with

generalized peritonitis at the fifth month of pregnancy. The abdomen was drained and the vermiform appendix removed. On the sixth day premature labour supervened and the foetus was expelled. Between this date and the twelfth day symptoms of intestinal obstruction appeared with great distension of the abdomen. A second operation was performed and the transverse colon was found to be distended as in the former case. The same procedure was adopted. The obstruction here was found to be due to the fact that before labour the great omentum had become adherent to the fundus of the uterus, embracing it like a horse-shoe. When the uterus descended into the pelvis on being emptied, it dragged the rolled-up omentum with it and kinked the colon at the splenic flexure, thereby leading to a complete obstruction and enormous distension of the colon.

These two cases illustrate certain somewhat unusual conditions, but they show the great practical value of evacuating the intestinal contents before performing even diagnostic manipulations in the abdominal cavity.

Colostomy.—This operation is performed with great frequency, although the general improvement in the technique of intestinal anastomosis has to some extent limited its application. It is at present a comparatively safe operation, especially as the lumbar or posterior operation has been abandoned, and its place taken by the inguinal operation with the aid of Paul's glass drainage tube. An efficiently performed colostomy which limits the undue retention of intestinal contents is a source of great comfort to a patient suffering from catarrhal colitis with profuse discharge of mucous material, while, however well performed for a case of disintegrating malignant disease of the bowel, the degree of comfort obtained for the patient is much less. The colon may be opened in any part of its course, but the posterior or lumbar operation has largely fallen into disrepute, as has also the caecal operation.

Colostomy does not prevent the passage of the intestinal contents into the distal portion of the bowel, and hence except as a temporary operation it is not to be recommended.

Indications.—For gynaecological affections pure and simple, these are few. Rarely, extensive malignant disease commencing in the uterus or the ovaries may invade the rectum or pelvic colon sufficiently to cause obstruction. The most common indication is a primary malignant affection of the rectum and pelvic colon. This operation is called for also as a temporary measure in any acute obstruction low down, where there is marked distension, *e.g.* in cases where the bowel has become kinked or strangulated by an adhesion. It is unnecessary to refer to other indications such as colitis, and tuberculous or dysenteric ulceration. More rarely it may be required for obstruction caused by pressure from without by tumours of the pelvis or of the female generative organs which are irremovable by operation. Lumbar colostomy is an operation which need never be considered by the gynaecological surgeon, as its indications even in general abdominal surgery are very few, and the same may be said of caecostomy, and ascending colostomy.

Transverse Colostomy.—This is sometimes required as in cases where, owing to the anatomical shortness of the pelvic mesocolon, iliac colostomy cannot be performed, and sometimes the operation is convenient as a temporary measure. The position of the anus is such that it can be easily regulated by the patient, and the separated fibres of the rectus abdominis muscle can be utilized to form a sort of sphincter. There is no tendency to prolapse, as in some cases of iliac colostomy, and the contents of the bowel are not so offensive as at the pelvic colon. It is always easy to close if performed for temporary purposes.

Operation.—A vertical incision is made at the level of the umbilicus through one or other rectus muscle, and the attachment of the great omentum is separated sufficiently to enable the bowel to be fixed to the abdominal wall, with as small an opening as possible. The further steps of the operation are similar to those of iliac colostomy.

Iliac Colostomy.—An oblique incision is made with its centre opposite the left anterior superior spine corresponding to the incision for the vermiform appendix or caecum on the right side. It is made nearer to the anterior spine than to the umbilicus so as to avoid the rectus abdominis muscle. The aponeurosis of the external oblique is incised in the same direction, the fibres of the internal oblique and transversalis muscles being separated in the direction of their fibres, that is to say, at right angles to the previous incision. The gap in the muscles is stretched, or enlarged with scissors, until an opening sufficiently large has been made.

If the bowel is distended, the pelvic colon will often bulge into the wound, unless its mesentery is unusually short. A loop of the pelvic colon is secured and its length ascertained by following it upwards, and displacing it into the pelvis until the upper end is reached, and it becomes taut. This is an important practical point. If the pelvic colon has a long mesentery and its lower portion is pulled out of the wound, the upper sagging portion is apt after a time to push the lower portion out and cause prolapse of the bowel, which is a troublesome complication.

A small opening is made in the mesentery, care being taken to avoid the vertical blood-vessels. Through this a glass rod or a rubber tubing of the thickness of the finger is passed, so as to anchor the bowel on the abdominal wall. It is well also to fix the upper and lower end of the intestinal loop by means of a through-and-through suture including the bowel and abdominal wall on each side. These stitches also fix the bowel in position, when the glass rod is subsequently withdrawn. Another method of fixation is by means of a strip of gauze or by various forms of pins, but the plan above described is simple and practical.

If the condition of the patient necessitates an immediate relief of the obstruction, the bowel should be well surrounded with gauze or sterile towels and a purse-string suture passed so as to include an area sufficiently large to permit of the introduction of a Paul's tube. This is fixed in position by tightening the purse-string suture into the groove between the two rims at one end of the tube (Fig. 225). It is well further to fix the bowel in the groove of the tube by some strong silk or linen thread. Rubber tubing is then applied to the distal end of the Paul's tube and led into a receptacle. The Paul's tube, as a rule, separates from the bowel on the fourth day or later, and the glass rod may be removed about the seventh day.

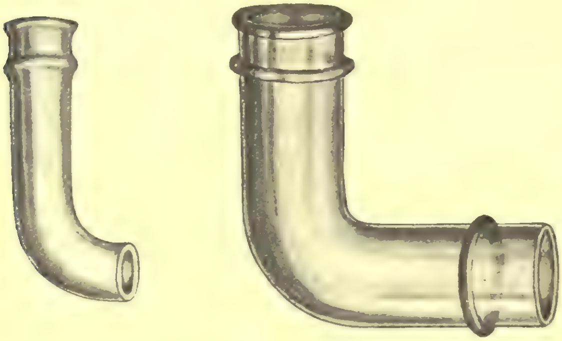

FIG. 225.—Paul's intestinal drainage tubes for colostomy or enterostomy.

If it is not absolutely necessary to open the bowel immediately, it is better to wait till the third day when a large opening is made in the bowel with a knife or the cautery.

Risks of Colostomy.—The immediate mortality of this operation is a negligible quantity, but certain complications may be associated with it.

Shortness of the mesentery, whether it arises from anatomical peculiarity or as the result of contraction after inflammation of the mesentery, offers certain technical difficulties. Unless the pelvic colon can be pulled entirely out of the abdominal cavity, it is better to make the opening in the transverse colon. It is never satisfactory to open the colon in the depth of the wound, as it tends to close sooner or later and a second operation becomes necessary.

Peritonitis as a complication is rare, probably from the fact that patients have, from the nature of the complaint, established a certain amount of immunity from infection.

Cellulitis in the abdominal wall is often troublesome. It generally results from some secondary interference with the wound, such as removal of stitches or the removal of the supporting rod, and not infrequently from disturbance caused by introducing a Paul's tube on the second or third day.

Occasionally, after the removal of the supporting rod, the loop of intestine tends to fall back into the abdominal cavity; or, as the result of intra-abdominal pressure due to coughing, coils of small intestine may be prolapsed alongside it through the opening.

One of the most troublesome complications is the failure of an artificial anus to act. This may mean a secondary obstruction due to a secondary growth higher up the bowel, or the impaction of faecal masses just above the colostomy-bend.

Prolapse of the mucous membrane is a serious complication and causes great discomfort to the patient. In mild cases the redundant mucous membrane may be cut away, but in severe cases, such as when several inches of mucous membrane are prolapsed, the bowel must be carefully freed and drawn out of the abdomen. The redundant portion is then removed and Paul's tubes tied into the ascending and descending loops of the bowel.

Colectomy

The performance of this operation presents difficulties not seen in enterectomy. This is due to the natural anatomical fixation of certain portions of the colon. Experience, however, goes to show that fixed portions of the colon may be freed and mobilized without much difficulty by division of the parietal peritoneum. This procedure has increased greatly the ease of the operation and diminished its mortality. Thus any portion of the colon may be freely mobilized with the exception of the deeper parts lying in the pelvis.

The arrangement of the lymphatic vessels and glands have been demonstrated chiefly by Jamieson and Dobson, with the result that the 'lymphatic areas' can be dealt with more radically than formerly. The lymphatics have been shown by them to correspond in their arrangement and course with the main blood-vessels of a particular segment, and their study affords an indication of the extent of bowel, mesentery, and peritoneum, which require to be removed in malignant diseases in a given situation. A study of these data has resulted in the employment of much more extensive operations for the cure of malignant disease, and although some surgeons contend that the results obtained by less extensive operations are quite as favourable, nevertheless since the anatomical investigations of Jamieson and Dobson have received the attention of surgeons, technique has been greatly improved.

Resection of Caecum and Ascending Colon.—The caecum has a mesocolon in only 30 per cent of the cases, and the ascending colon is also frequently without a mesentery. The caecum occasionally has a very long mesentery as in *caecum mobile*, where it hangs down into the pouch of Douglas like a flaccid bag.

In removing this portion of the bowel for malignant disease, it is well to remember that due attention to the area of lymphatic drainage points to the necessity of removing *en bloc* the last 3 or 4 inches of the ileum, the caecum, the ascending colon, the hepatic flexure, and the right one-third of the transverse colon. Not only do anatomical reasons indicate this wide area of removal, but the resection of small portions of bowel is a much more difficult operation than that above indicated; therefore from the practical point of view, the junction of the ileum into the transverse colon is a comparatively simple operation, and if carried out with satisfactory technique, it is not associated with much shock to the patient.

The most useful incision is made in the right linea semilunaris about 6 inches in length, so as to allow a thorough exposure of the area to be removed. This incision has the disadvantage that it is apt to cut across the terminal branches of the lower dorsal nerves as they enter the rectus sheath and thereby lead to partial paralysis of this muscle, but with care it is only necessary to divide one of these nerves near the middle of the incision, the others being preserved, by displacing them upwards or downwards to the upper and lower angles of the wound.

The bowel is mobilized along its outer margin by dividing its attachment to the parietal peritoneum, the colon and caecum being raised and drawn forwards and inwards (see Fig. 222). There are no vessels in this outer layer of the peritoneum, so that there is little haemorrhage associated with this procedure. Clamps are then applied at the points at which it has been decided to divide the bowel (see Figs. 223 and 224). It will often be found advisable to divide the distal end of the bowel first, namely at the transverse colon. After cleaning the divided ends these are wrapped in gauze and the removal continued in a downward direction. The large vessels should be caught and divided at some distance from their entrance into the bowel, as the amount of haemorrhage is thereby materially diminished, there being no interference with the anastomotic arches situated close to the bowel. Care should be taken during the stripping down of the bowel from the posterior abdominal wall not to injure the underlying duodenum and ureter. The freed colon and caecum are then brought outside the abdominal cavity, and the ileum is divided.

One of three procedures may now be adopted. The proximal and distal ends of the bowel may be closed and a lateral anastomosis performed between the ileum and the transverse colon (Fig. 224), or a simple end-to-end junction may be made of the ileum into the colon, or an end-to-side anastomosis of the one into the other may be carried out. Of these the preferable and probably the safest method is the complete closure of the two ends of the bowel and a lateral anastomosis. In some cases where the proximal bowel is dilated and hypertrophied so that the lumen is similar in size to that of the distal bowel, an end-to-end junction is easy and satisfactory. An end-to-side anastomosis in this region is as a rule unsatisfactory.

If lateral anastomosis has been decided upon, the ends of the bowel are crushed by some form of crushing clamp, a ligature applied to the crushed portion, and the whole end inverted into the lumen of the bowel by means of a purse-string suture. The procedure thus adopted is similar to that used in the treatment of the appendix-stump after removal of the vermiform appendix. Lateral anastomosis is then performed by the double-row suture of Czerny-Lembert or its modification (see enterectomy), the opening into the colon being made through the longitudinal band.

Finally it is important to close the opening in the posterior parietal peritoneum by drawing up the free margin of the divided enteric mesentery and uniting it to the peritoneum passing from the end of the transverse colon to the posterior abdominal wall. If there have been adhesions to the retroperitoneal tissues, it is well to pass a posterior drain into the retroperitoneal space.

Resection of the Transverse Colon.—The method of operation adopted here depends on whether the disease is situated towards the hepatic or splenic flexures, or is in the middle of the transverse colon.

If the disease is towards the hepatic flexure, Dobson recommends the removal of part of the ascending colon and two-thirds of the transverse colon. The divided ends are then closed and ileo-sigmoidostomy is performed. The author has, however, seen trouble caused by the blind proximal pouch which is left in such an operation.

If the disease is in the middle of the transverse colon, such a wide operation is scarcely necessary, as it has been pointed out by Jamieson and Dobson that the lymphatic vessels do not pass directly to the main groups of lymphatic glands but are intercepted in the para-colic lymphatic glands.

When the disease is towards or involves the splenic flexure of the colon, its deep position renders manipulation more difficult. End-to-end union is often dangerous, because of the tension upon the line of junction, so that lateral anastomosis, though difficult, is preferable, though the mobilization of the descending colon is not always an easy one. Similarly in the case of the descending colon, the success of the operation depends largely on the degree of mobility of the bowel.

Resection of the Pelvic Colon.—The pelvic colon is the seat of the disease in nearly 40 per cent of cases of carcinoma of the large bowel. From its position this complication not infrequently comes under the notice of the gynaecological surgeon, and when lying low down in the pouch of Douglas it may be mistaken for growths of uterine or ovarian origin.

In operation for these conditions the patient is placed in the Trendelenberg position. After ascertaining the exact position of the growth, mobilization must be effected as an important first stage of the operation. For this purpose the mesenteric border is detached at its junction with the parietal peritoneum, so that the affected loop may be drawn forward and removed with the corresponding portion of the mesentery. Union is best performed by closure of the two ends and a lateral anastomosis. A point of great practical importance in this operation, as pointed out by Jamieson and Dobson, is the preservation of the left colic branch of the inferior mesenteric artery.

It will be remembered that the inferior mesenteric artery arises about 2 inches above the bifurcation of the aorta, and in its vertical course gives off its two main branches, the left colic, and the sigmoid arteries. The left colic artery is a vessel of great importance as it supplies a larger segment of the colon than either of the other two colic arteries; its anastomoses extending from the middle of the transverse colon to the lower part of the pelvic colon. The surgeon will understand that the preservation of the left colic branch is of vital importance, in order to preserve the vitality of the bowel. The inferior mesenteric artery is therefore exposed, and tied immediately *below* its left colic branch, after which the mesentery of the descending and pelvic colon is divided on the outer side, so as to mobilize the bowel. After dividing the mesentery on the inner aspect of the bowel, the gut can be clamped and removed. The tissue removed will therefore consist of the bowel and its mesentery, containing the inferior mesenteric vessels with the accompanying lymphatics down to the rectum. The blood supply of the upper end of the bowel which is left *in situ* is preserved intact, and by preserving the secondary arches of the sigmoid artery below, the anastomoses of the lower end when united to the upper will be sufficient.

Resection of the Rectum.—This is considered in a special article upon the diseases of the rectum (p. 245).

Enterectomy and Intestinal Anastomosis

In this operation the affected loop of intestine is brought outside the abdominal cavity. It must then be decided by the operator whether he will perform an end-to-end anastomosis or close the divided ends of the bowel and perform a lateral anastomosis. As a rule end-to-end anastomosis is the more satisfactory operation.

End-to-end Anastomosis; Circular Enterorrhaphy.—In considering this operation it is important to remember the anatomy of the mesenteric attachment. The mesentery as it approaches the intestine splits to enclose it, leaving a Λ-shaped space loosely filled up with fat, and containing the blood-vessels supplying the intestine. It is most important to ensure an accurate closure of this space.

The intestine should be clamped about one inch from the point of suture, so as not to cause any tension on the line of suture during the process of stitching.

The divided ends of the two segments of intestine having been approximated are united by a single stitch of catgut or linen thread inserted near the mesenteric attachment. This is the fixation- or steadying-suture (Fig. 226). Next, the peritoneal surfaces of the two segments are united by a continuous stitch (Fig. 226, B). A continuous suture then passes round the whole lumen of the bowel, including all the intestinal coats; this suture serves to check the haemorrhage, and restores the continuity of the lumen of the bowel (Fig. 226, C). An additional mattress suture is inserted to occlude thoroughly the space at the mesenteric attachment.

A second continuous Lembert suture is then applied, beginning opposite the mesenteric attachment and passing round the whole circumference of the bowel. The stitches should only be pulled tight enough to procure an easy approximation, as many mishaps may result from the drawing of the stitches too tight, causing local death of the tissues.

The mesenteric rent must then be carefully closed after ensuring a complete haemostasis of the enclosed blood-vessels.

End-to-end suture may also be performed by various methods of stitching or by the use of Murphy's buttons or bone bobbins. It is unnecessary here to refer to these different methods as many of them are equally good, and can be acquired with ease, provided the general principles of intestinal anastomosis are thoroughly understood.

Simple Lateral Anastomosis or Exclusion.—Simple lateral anastomosis without excision of bowel is not as a rule a satisfactory operation, owing to the fact that it does not entirely divert the stream of intestinal contents from the occluded loop of bowel, so that stagnation is apt to occur in a segment of the intestine which leads sooner or later to trouble. It is, however, indicated in certain cases of chronic obstruction in which extensive or radical measures are contra-indicated (Fig. 227). It can also be performed some time previously as a preliminary to a radical operation, and in any case it is only a satisfactory operation in cases of a chronic nature. Its greatest usefulness is probably found in cases of tuberculous adhesions, and it is often most satisfactory when more than one anastomosis is desirable.

In performing the operation, care should be taken that there is no tension on the united segments of intestine. Thus the best forms of anastomosis are between the large and small intestines. Ileo-colostomy, and ileo-sigmoidostomy are much more

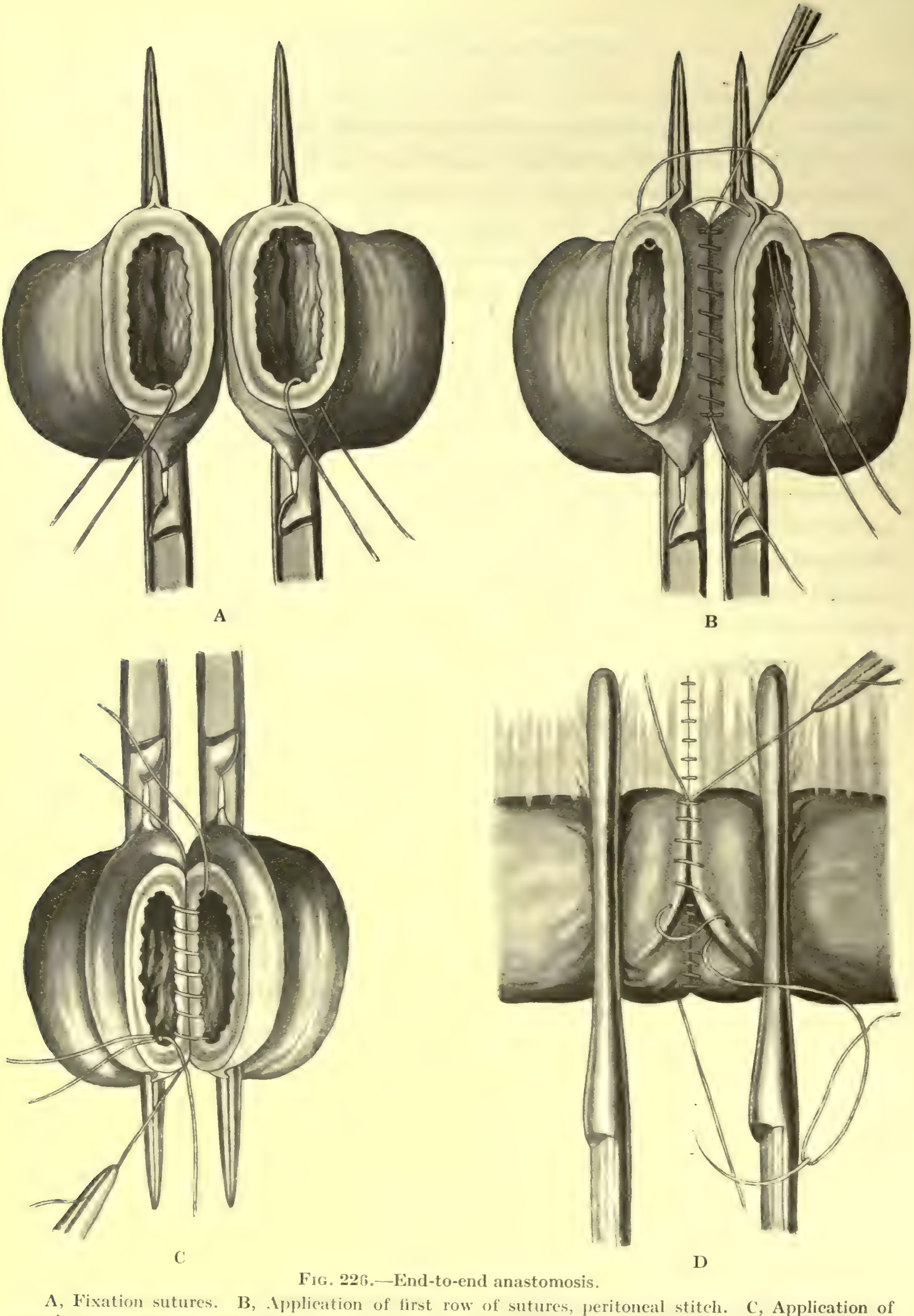

Fig. 226.—End-to-end anastomosis.

A, Fixation sutures. B, Application of first row of sutures, peritoneal stitch. C, Application of second row of sutures, through-and-through stitch. D, Completion of peritoneal stitch and closure of mesentery.

satisfactory operations than colo-colostomy; the results of practical experience go to show that a greater proportion of failures occur in the latter than in the former operation.

The exclusion of a certain segment of bowel may be unilateral or bilateral. In the former case the excluded segment is cut off from the rest of the intestinal tract at its proximal end, while in the bilateral an excluded piece of bowel is left closed at both ends. It need hardly be said that bilateral exclusion has proved itself to be a most unsatisfactory operation, as intestinal secretions and gases form which lead to auto-intoxication. It need never be considered therefore as a feasible operation, unless a second anastomosis is made between the enclosed segment and the general intestinal tract.

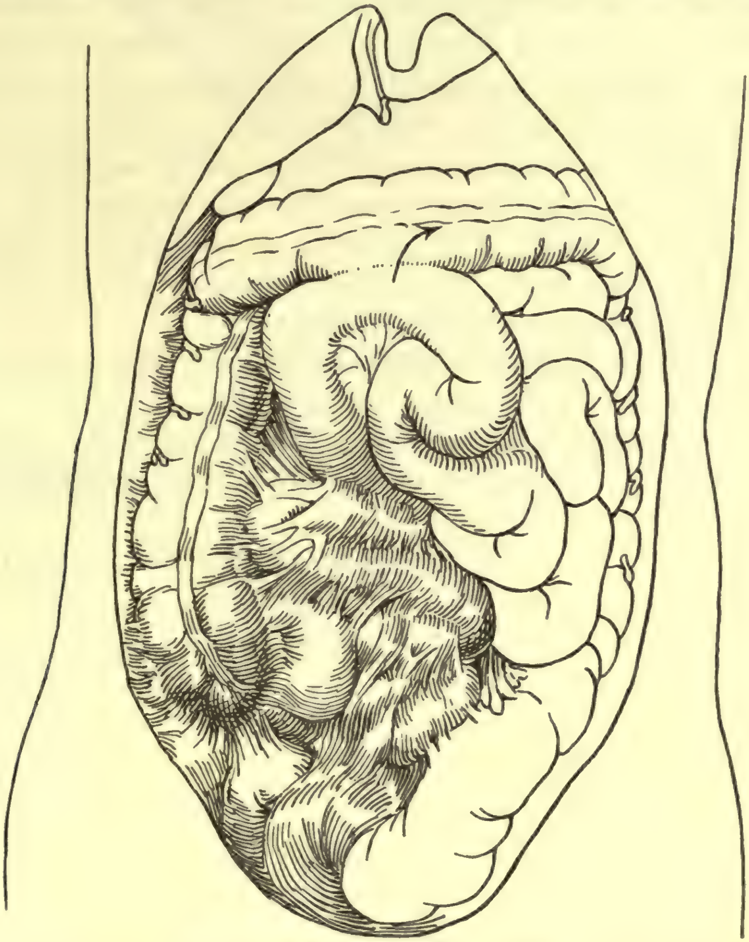

Fig. 227.—Simple unilateral exclusion.
Union of ileum to transverse colon in a case of multiple dense adhesions.

Unilateral exclusion (ileo-sigmoidostomy) is much more widely employed, and is often of much value to the gynaecological surgeon. There is a tendency even in this operation to an accumulation of secretions and of gas in the 'excluded' gut, though some surgeons deny it. Exclusion has been largely advocated in recent years by Arbuthnot Lane, but owing to the disadvantages above stated a resection of the isolated segments of the colon has often been called for at a later date. We may consider ileo-sigmoidostomy as a typical instance of this operation (Fig. 227).

The author has performed simple lateral anastomosis without exclusion in two cases of adhesions due to old peritonitis of pelvic origin, with satisfactory results. In both cases a double anastomosis was performed uniting the middle jejuno-ileum with the jejunum high up on the one hand, and with the ileum low down on the other. In both cases resection of the bowel was contra-indicated owing to the wide extent of the adhesions. These openings form most useful safety-valves and do not interfere with the general nutrition of the patient.

Ileo-sigmoidostomy being compatible with good nutrition, in most cases results in definite improvement in the condition of the patient.

Operative Technique.—This is similar in its essentials to the performance of a lateral anastomosis after resection of the intestine. The stages of the operation are shown in Figs. 228-229.

The lower end of ileum is chosen sufficiently high above its junction with the caecum to ensure free mobility, and an enterotribe then applied to the bowel at two places half an inch distant from each other. Each crushed area of bowel is surrounded by a circular suture and tied; the bowel is then divided and the ends inverted by some form of purse-string suture.

The proximal portion of the ileum is then adjusted to the pelvic colon so that the long axis of each lies parallel to the other. The ileum is then attached to the colon by a single peritoneal suture, so placed that the anti-mesenteric border is attached to the colon in such a manner that the new opening will be in the free longitudinal band of muscular fibres. This may be used as an additional fixing suture prior to a Czerny-Lembert stitch in two rows, or may be made the first of the two rows, according to the wish or experience of the surgeon.

It is rare for failure of union to occur in this variety of anastomosis, even though it is so frequently performed upon patients whose general condition is highly unsatisfactory. It is naturally most successful in cases of intestinal stasis, intestinal fistulae and cases of non-malignant intestinal obstruction.

End-to-side Implantation.—This is also a method which is very useful in ileo-sigmoidostomy and in all junctions of small to large intestine.

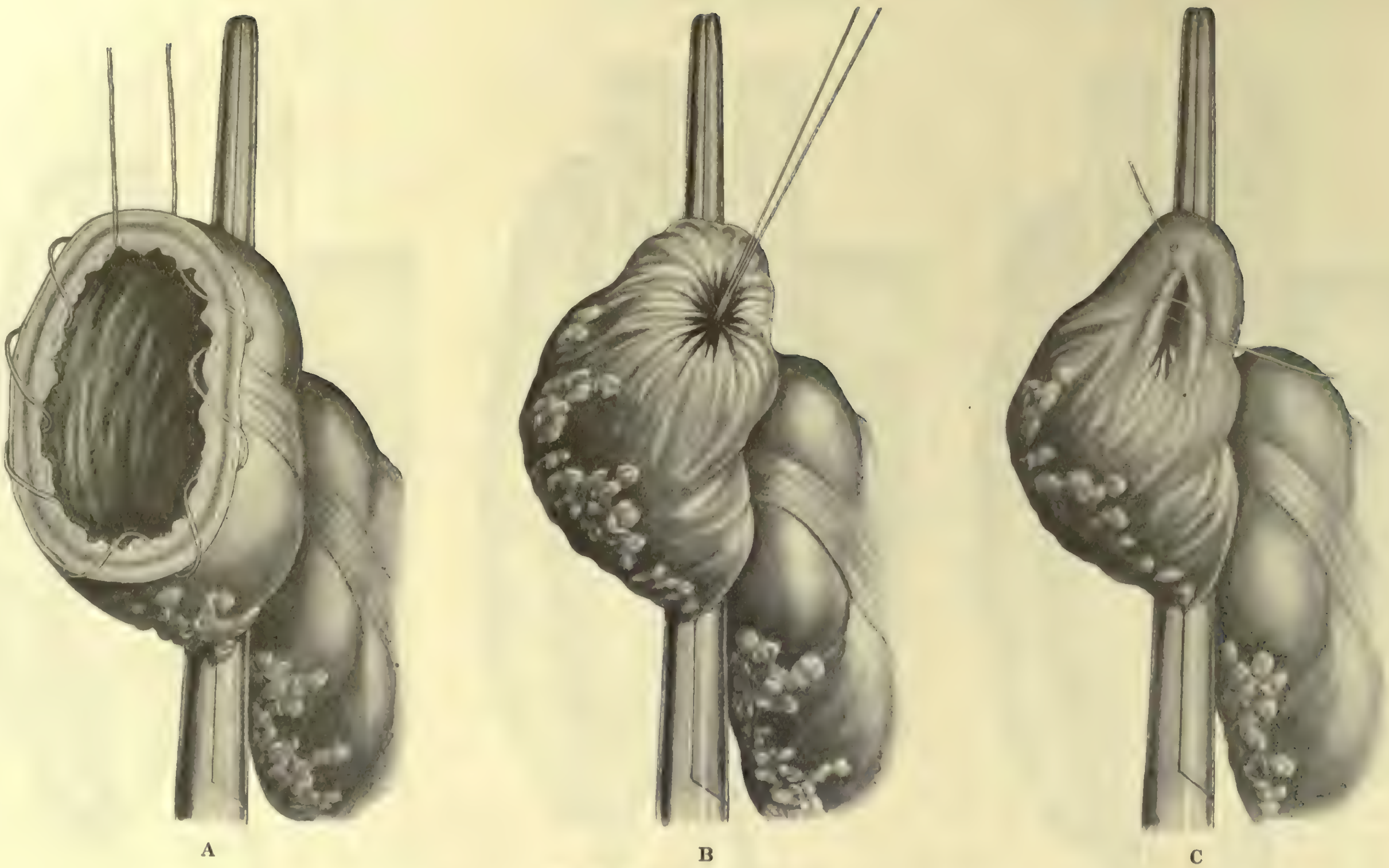

Fig. 228.—Lateral anastomosis.

A, Closure of divided end of colon by purse-string suture, Stage I. B, Purse-string suture tied, Stage II. C, Final closure by continuous peritoneal suture.

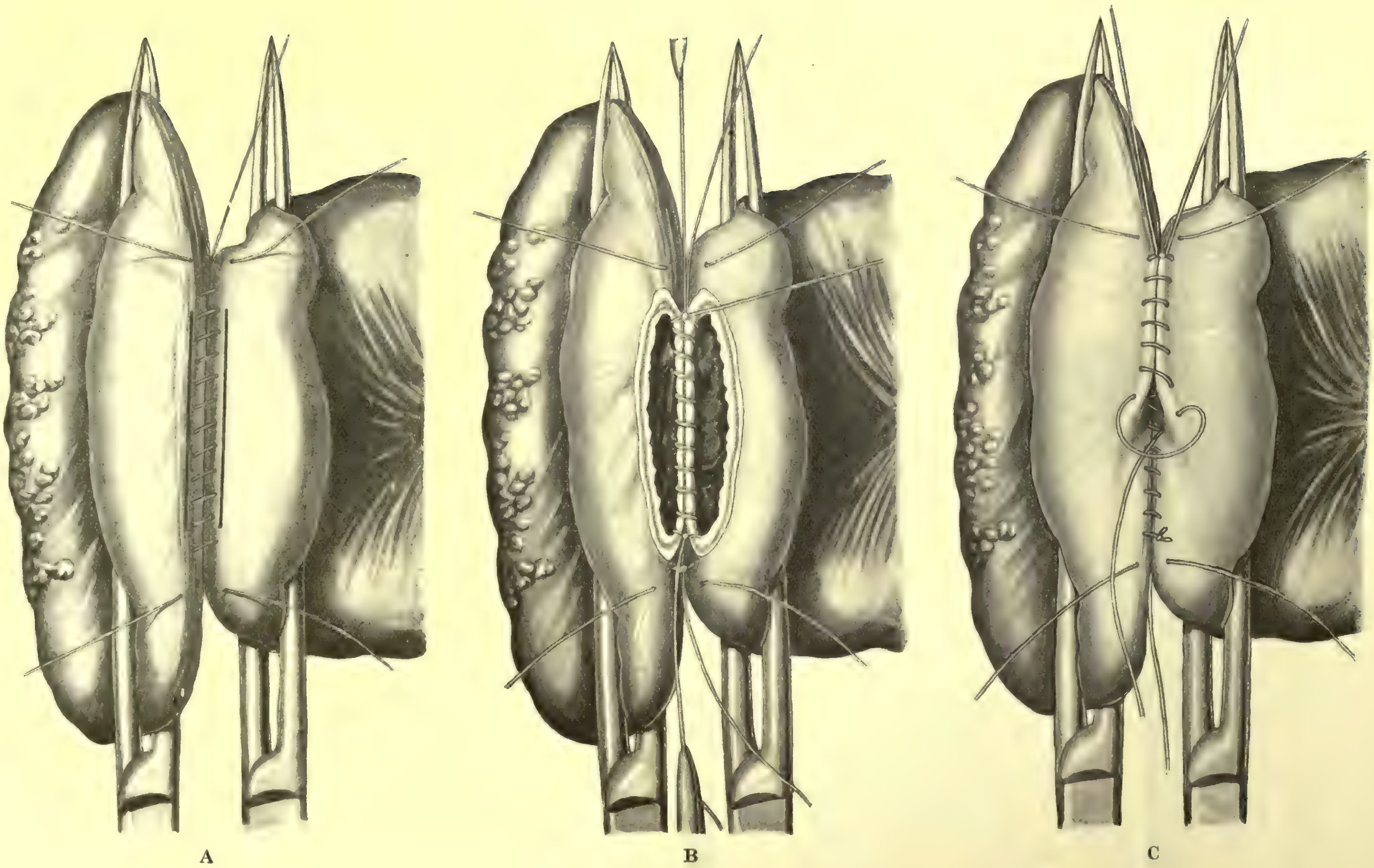

FIG. 229.—Lateral anastomosis.

A, Union of bowel, Stage I. B, Union of bowel, Stage II. C, Union of bowel, Stage III.

It has the disadvantage, however, that the size of the anastomosis is necessarily limited, and in many cases appears to be rather small, or even liable to contraction. This method has been used considerably by Arbuthnot Lane.

The bowel is crushed and divided as in the previous operation. The method of union is shown in the following diagrams (Fig. 230). A fixation row of sutures may be used to anchor the lower end of the ileum to the colon. These are placed about $\frac{1}{8}$ inch distant from the line of true bowel suture, which is now applied, uniting the peritoneal coats of ileum and colon posteriorly. An incision is then made in the longitudinal muscular band of the colon of sufficient length to fit as accurately as possible the lumen of the small intestine, and a continuous circular suture including all the coats of both pieces of bowel inserted. This incision lies in the fibres of the longitudinal band of the colon. Finally the anterior half of the external Lembert suture is completed.

As in lateral anastomosis a preliminary fixing Lembert suture further to anchor the bowel in position may be used, before the true anastomotic sutures are applied. This is often advisable and is to be recommended, as it tends to diminish any inclination to kinking of the new junction. There is no doubt, however, that the weakness of the operation of lateral implantation is its tendency to contract, and for this reason the true lateral junction is to be preferred. If there is any doubt about the efficiency of the closure it may be much strengthened by the use of omental flaps or grafts. This often seems to minimize the danger of leakage. Appendices epiploicae may also be used to reinforce the line of suture.

Closure of Faecal Fistulae

As a rule, if the general lumen of the intestinal tract is free, a spontaneous cure of a faecal fistula takes place sooner or later. Therefore the surgeon should be in no hurry to close a faecal fistula, but should give Nature due time even if extended over a period of months, to heal the fistula by natural means. If a fistula has persisted for months or years, it will probably never heal spontaneously.

It is questionable if minor methods of treatment should be adopted in these cases. Surgical tinkering, such as the use of the cautery, superficial closure by skin-flap or sutures, is unsatisfactory in the majority of cases, and disheartens the patient as well as discredits the surgeon. The true surgical method is the thorough exposure of the opening in the bowel itself. The principle of the successful closure of a faecal fistula consists in the free separation of the bowel adherent to the abdominal wall, its thorough *mobilization and isolation*, and the inversion of the

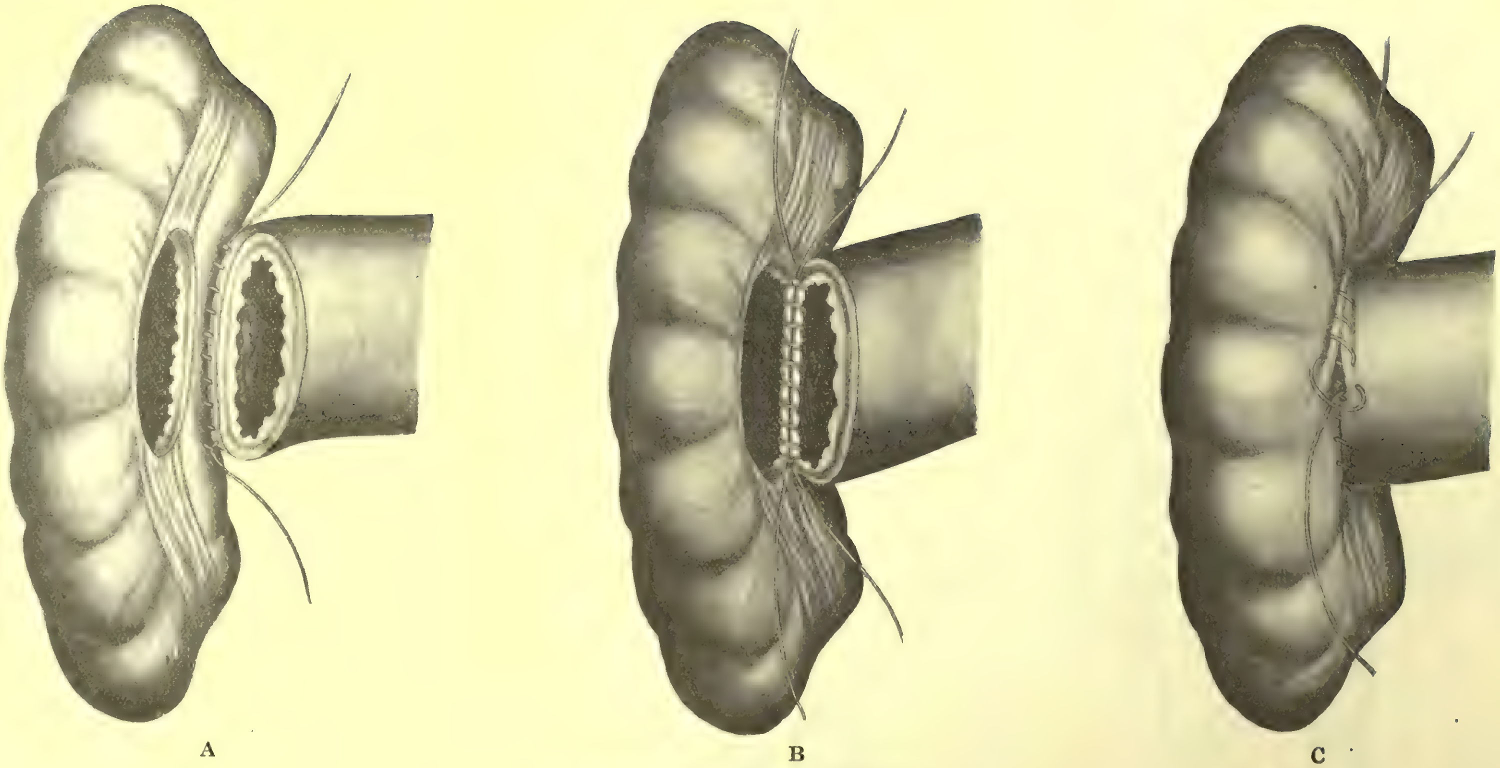

Fig. 230.—End-to-side anastomosis.
A, First stage. B, Second stage. C, Final stage.

edges of the fistula into the lumen of the bowel. If these principles are adopted, the success of the surgeon in the treatment of faecal fistula will be uniform.

In rare cases, resection of a segment of intestine or the exclusion of the fistulous segment by a lateral anastomosis may be necessary. The success of the operation depends upon surgical cleanliness and technique and the drainage for two or three days of that portion of the peritoneal cavity in which the fistula previously lay.

Internal Fistulae.—Fistulae occurring between the intestines and the bladder, uterus, Fallopian tubes, and vagina can also be cured if the above principles can be carried out, namely the isolation and mobilization of the two organs, and the inversion of the fistulous edges into the cavity of its hollow viscus.

VAGINAL COELIOTOMY

By Professor Howard C. Taylor
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Operations through the vagina require greater skill and dexterity than operations through the abdomen. Formerly when the danger of peritoneal infection was feared more than now, the indications for vaginal operations were larger than at the present time, and, with the exception of certain inflammatory cases needing only drainage, and some ovarian cysts associated with pregnancy, most cases that are operated upon through the vagina could be done as easily through the abdomen. That the mortality following vaginal operations for the same type of cases is less than from abdominal operations is doubtful. The easier cases are operated upon through the vagina and the more difficult ones through the abdomen, and naturally there is a higher percentage of mortality for the latter. This is due to the nature and extent of the lesion and not to the operation.

The real size of the uterus and of the vagina, together with the existing amount of prolapse of the two organs, that is, the amount of relaxation of their ligaments, are the determining factors in deciding between the vaginal and the abdominal routes for abdominal operations. In a nulliparous or virginal woman without any vaginal prolapse, any intraperitoneal operation through the vagina other than a simple drainage is associated with difficulty and is rarely indicated. A woman who has had children has a larger vagina, and the uterus can usually be reached more readily and delivered into the vagina. With a marked or complete prolapse of the uterus and of the vaginal walls, intraperitoneal operations on the uterus and appendages are easily performed through the vagina, and are limited only by the size of the growth to be removed.

Advantages of the Vaginal Route.—(*a*) *Infection.*—When the uterine appendages become diseased from infection, new growth, or a tubal pregnancy, their increase in weight carries them into the *cul-de-sac* of Douglas. If there is present any infection that is at all virulent, the intestines become adherent about them and protect the general peritoneal cavity from its influence. If the case is operated upon through the abdomen, the intestinal barrier must be broken down before the diseased appendage is reached and the peritoneal cavity exposed to the risk of infection. If the case is approached through the vagina, this barrier need not be disturbed at all, with a corresponding decrease in risk of peritoneal infection. This risk of peritoneal infection is not feared as it was formerly, but it is still a factor to be considered, as there are yearly many deaths from peritoneal infection following abdominal operations.

(*b*) *Hernia.*—The danger of hernia through an abdominal incision is also much less than formerly when wound infections were more frequent, and it is no longer a strong reason for selecting the vaginal route. Through a Pfannenstiel incision a hernia rarely occurs, and the danger of it can practically be ignored.

(*c*) *Scar.*—This in itself cannot be used as a strong argument in favour of the vaginal route, but the suggestion that it gives is one that many women prefer to avoid. A small Pfannenstiel incision made below the line of the pubic hair will give as free access to the pelvis as a vaginal incision in most cases, and the scar can hardly be found after a few months.

(*d*) *Shock.*—It is an unquestioned fact that there is much less shock following vaginal than abdominal coeliotomies, and it is not easy to give it an adequate explanation. It is not on account of less exposure of the intestines, because working through a small abdominal incision with the patient in the Trendelenberg posture there is no more exposure or handling of intestines than in a vaginal coeliotomy. Neither is it due to less dragging on the tissues, as in many vaginal hysterectomies there is more pulling on structures than in a hysterectomy done on the same type of case through the abdominal wall; yet following the operation the patient will have less shock and complain of less post-operative discomfort. The followers of Crile might well claim that the less shock following operations through the vagina is due to the smaller number of sensitive nerves that are divided in entering the peritoneal cavity through the vaginal instead of the abdominal wall.

(*e*) *Shorter Convalescence.*—As there is less immediate shock from the vaginal operation, so also is there a shorter period of convalescence. The laity as well as the profession appreciate that a patient is not well the day she leaves the hospital after an operation, but that some days or weeks must elapse before she is back to her normal condition and has received the full benefit of the operation. The time required in the hospital as well as that for the complete recovery of the patient is distinctly shorter after a vaginal than after an abdominal coeliotomy.

Disadvantages of the Vaginal Route.—(*a*) *Difficult Technique.*—An operation through the vagina often is more difficult and requires greater skill than the same operation through the abdomen. The time consumed for the removal of appendages through the vagina is distinctly longer than through the abdominal wall.

(*b*) *Restricted Field.*—Even with a large vagina, the operative field is often limited for the operation in hand, and, furthermore, there is no opportunity of investigating other organs in the abdomen. It is well known that, in addition to the pelvic organs, other organs in the abdomen may be involved, and not infrequently, even with the greatest care, a correct diagnosis cannot be made without opening the abdomen and seeing the organs. An operation through the vagina may therefore only incompletely relieve the patient of symptoms for which she submitted to operation.

(*c*) *End-Results.*—It is not possible working through the vagina to close over raw areas with peritoneum as well as can be done through the abdomen. This means that peritoneal adhesions, with the possibility of post-operative discomfort, are more likely to form.

(*d*) *Accidents.*—Haemorrhage either during or after the operation is a more frequent accident in the vaginal than in the abdominal route, and special care should be taken that each vessel is clamped or ligated before it is divided to avoid this accident. The bladder, the ureter, and the rectum are all more frequently injured in vaginal than in abdominal operations, and special precautions are necessary.

To summarize: the advantages of the vaginal route are—less danger of infection, less shock, shorter convalescence, no scar, and no hernia; the disadvantages are the greater difficulty of the operation, the restricted field with no opportunity of examining other viscera, the greater danger of troublesome peritoneal adhesions, and more frequent operative accidents.

The scar, the risk of hernia, and a longer convalescence are matters of small importance compared with the life or the subsequent health of the patient. It is therefore my strong opinion that vaginal coeliotomies, with the exception of vaginal hysterectomies, should be limited to drainage cases, to simple excisions through large vaginae by trained surgeons, and to patients whose physical condition is such that an operation associated with the least shock should be selected.

TECHNIQUE

Position of Patient.—Vaginal coeliotomies are invariably done with the patient in the dorsal position. The leg holders should be so arranged on the table that the patient can be raised into the Trendelenberg position (see Fig. 82, p. 320). This will force the intestines to leave the pelvis and allow a better inspection of the operative field.

Instruments.—A strong light, either an electric head-light or a movable light arranged to throw the rays directly into the vagina is necessary to give the proper illumination of the operative field. In addition to the usual surgical instruments, a liberal supply of vaginal retractors with blades six or seven inches long, some an inch and a half and some two inches wide, are required. A strong light and proper retractors may save the operation from failure and avoid the necessity of opening the abdomen to control haemorrhage.

Disinfection of the Vagina.—Previous to the operation the vulva and pubes are shaved, and the patient is given a vaginal douche of a mild sterile solution, such as boric acid, normal salt solution, or plain water. I do not use the stronger antiseptic douches, such as solutions of carbolic acid or bichloride of mercury. After the patient is anaesthetized and in position for the operation, the vulva and the neighbouring parts are washed thoroughly with a solution of soft soap and a constant stream of sterile water. The vagina is washed in the same manner with gauze fastened to a clamp or to a sponge-holder.

Before inserting the vaginal speculum, to avoid contamination and infection from the anus, it should be covered with a sterile towel clamped directly to the skin. After the cervix has been exposed, the vagina is sponged dry and then painted with a 50 per cent solution of tincture of iodine. In doing this, special attention should be directed to the cervical canal, as pyogenic germs may be present in it as high as the internal os of the uterus. Any mucus in it should be sponged out, and a piece of gauze soaked in the solution of iodine should be allowed to remain in it for one or two minutes.

While the use of iodine as a means of sterilization of the field of operation is more effectual if applied to a dry surface, it is in the writer's hands the most reliable means of sterilizing the vagina for the vaginal operations.

Incisions.—The peritoneal cavity can be opened from the vagina either through the anterior or posterior fornix. The incision through the anterior fornix requires a longer time to make, it necessitates displacing the bladder, but gives better access to the uterus and appendages, as, if necessary, they can be delivered through it from the peritoneal cavity into the vagina. This incision is the one to be used for the removal of diseased tubes and for small tumours of the ovaries and uterus. Except in most unusual cases, it is not used for drainage purposes.

The incision through the posterior fornix can be made more easily and quickly, often if desired with a single cut with the scissors, as only the vaginal wall, the peritoneum, and the cellular tissue between them have to be divided. No viscera have to be displaced to make the incision, and with reasonable care no organs can be accidentally injured. This incision does not give sufficient access to the uterus and appendages for proper visual inspection, but serves for palpation. Unless the uterus is retroverted and the ligaments relaxed, it is not easy to deliver the uterus or the appendages through the posterior vaginal incision. The incision is in the deepest part of the floor of the pelvis and is the ideal incision for drainage. It should not be used for the removal of diseased organs except for small non-adherent ovarian cysts, especially if associated with pregnancy.

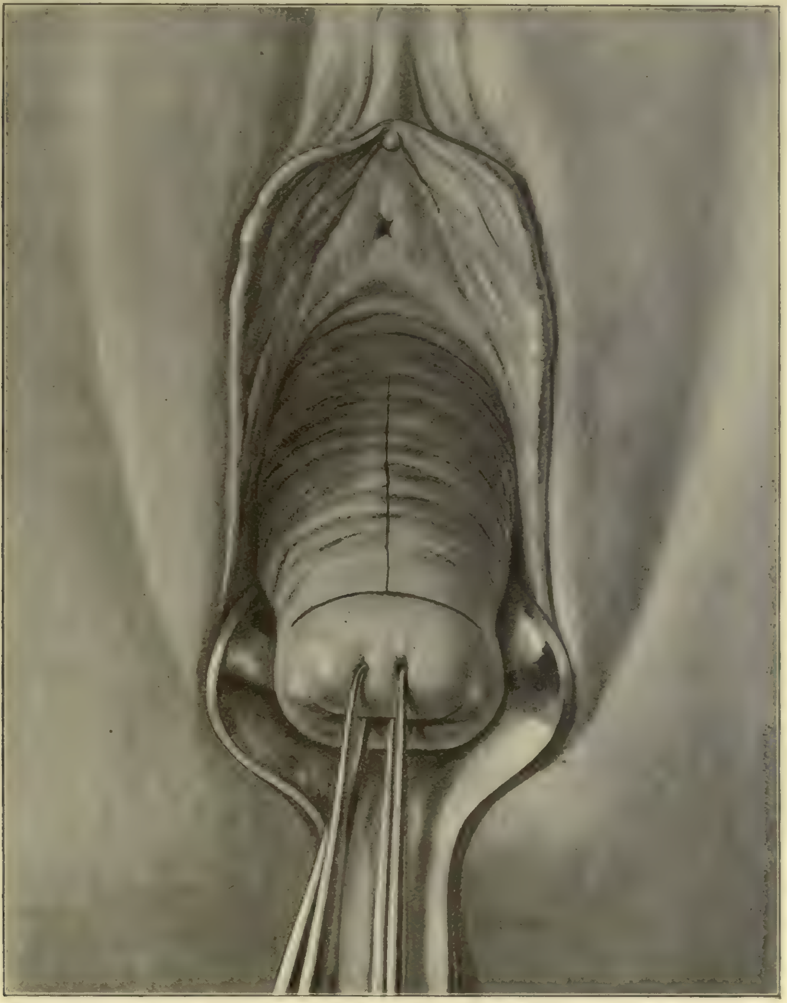

Fig. 231.—The lines of the anterior vaginal incision.

Technique of Anterior Vaginal Incision.—A posterior vaginal speculum held by the nurse is used to expose the cervix. A volsellum forceps is attached to the cervix and drawn downward and backward, another volsellum forceps is attached to the anterior vaginal wall just above the urethra and drawn forward. The anterior vaginal wall should be divided from the second forceps up to the point where it is reflected from the cervix. Usually, but not always, this incision is supplemented by a second incision extending around the cervix from one side to the other, meeting the first incision at right angles to its cervical end. This makes a T incision (Fig. 232). A vaginal flap is dissected back on each side, exposing the bladder. The separation

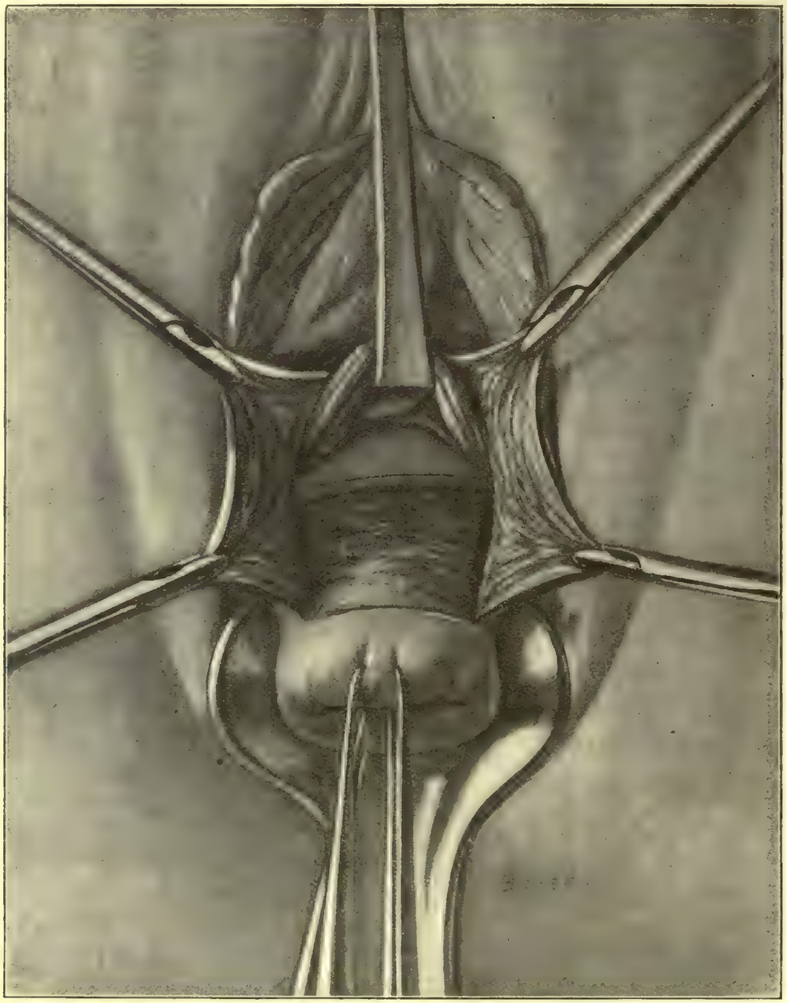

FIG. 232.—The anterior vaginal incision with the vaginal flap turned back, exposing the bladder.

of these flaps from the bladder is easy if the proper plane of cleavage is reached, and it is easier to find the proper plane of cleavage in the middle of the vertical incision, where it is attached lightly to the bladder, than higher up, where it is more firmly attached to the cervix. After the proper plane of cleavage is found at one place, the vaginal flaps can easily be separated from the bladder, working from that point, and largely by blunt dissection. After the vaginal flaps have been dissected back, the bladder, which will have been exposed, is separated from the anterior surface of the uterus as high as the utero-vesical fold of the peritoneum (Figs. 233 and 234). Here again, it is necessary to find the proper plane of cleavage

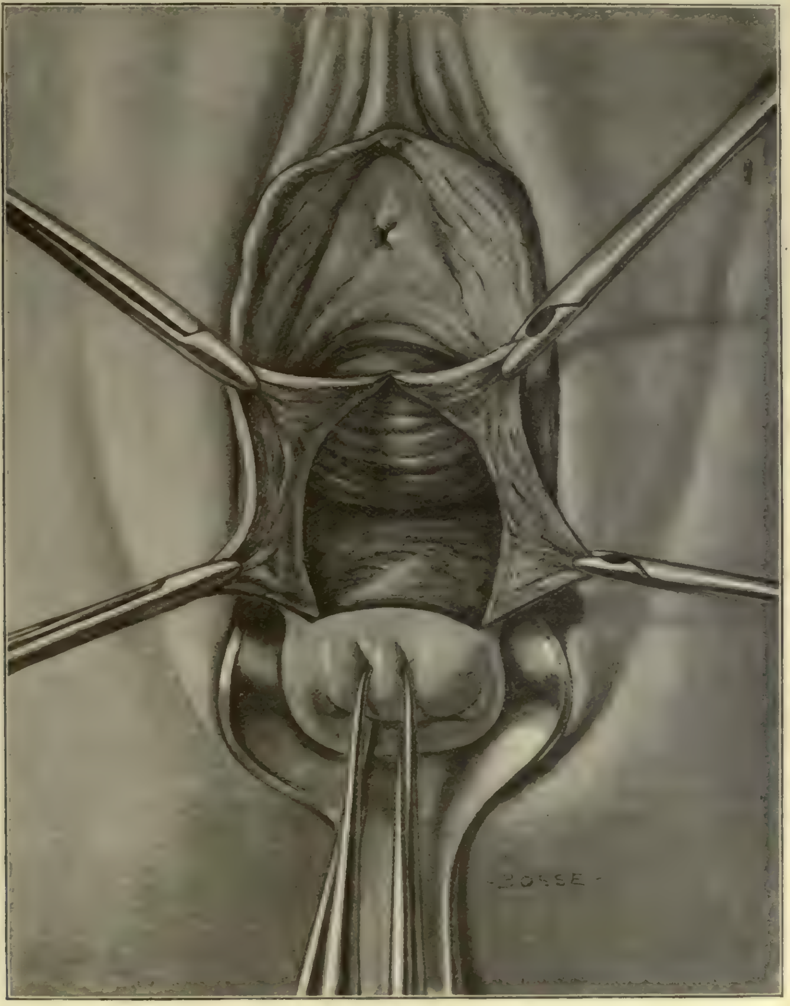

FIG. 233.—The bladder elevated exposing the utero-vesical fold of peritoneum.

between the bladder and the uterus. If this is done, the separation is made easily with blunt dissection, except near the cervix, where there is a utero-vesical ligament that has to be divided with the scissors. Special care must be taken not to injure the bladder, and, as an injury to the bladder is more serious than one to the uterine wall, the mistake most frequently made is in working too close to the uterus and entering its wall. The use of a sound introduced into the bladder to outline the limits of the bladder should be avoided. It may cause injury to its mucous membrane, and, as it may easily displace the bladder wall, it does not give its true outline. The bladder wall must be recognized as such when it is reached. It is

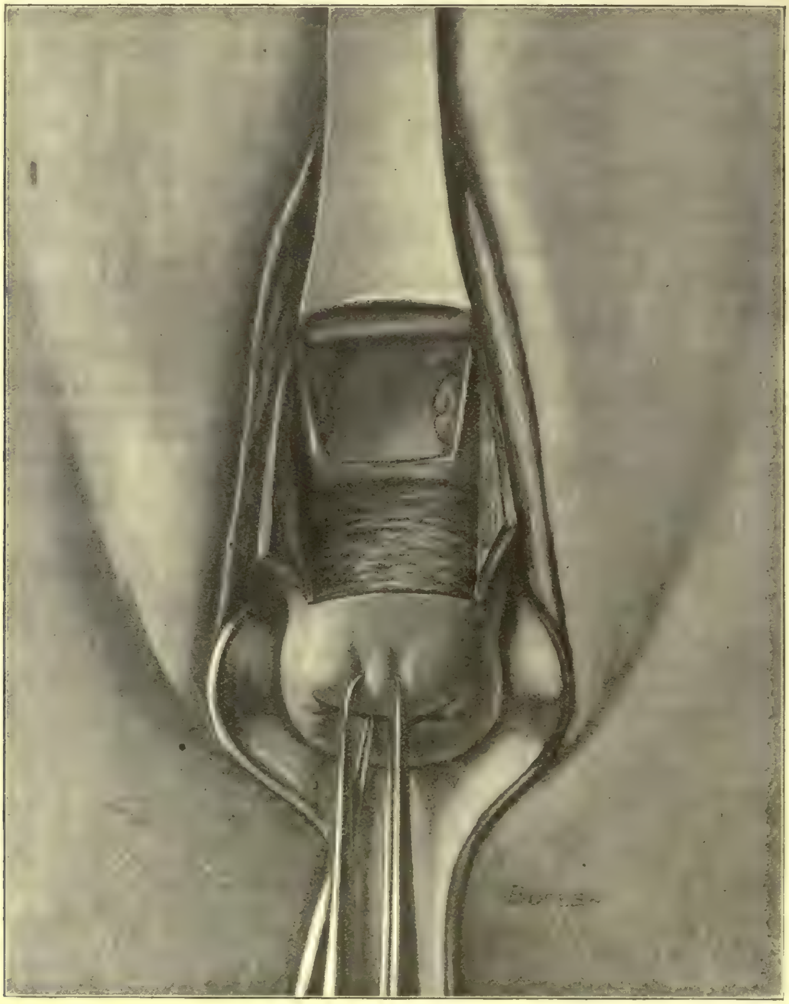

FIG. 234.—The utero-vesical fold of peritoneum incised showing the uterus in its normal place.

best to begin its separation from the uterus at one side and work towards the middle line under the utero-vesical ligament. If the proper plane is not found at once, then an attempt should be made from the other side. Usually there is no great difficulty in making the separation.

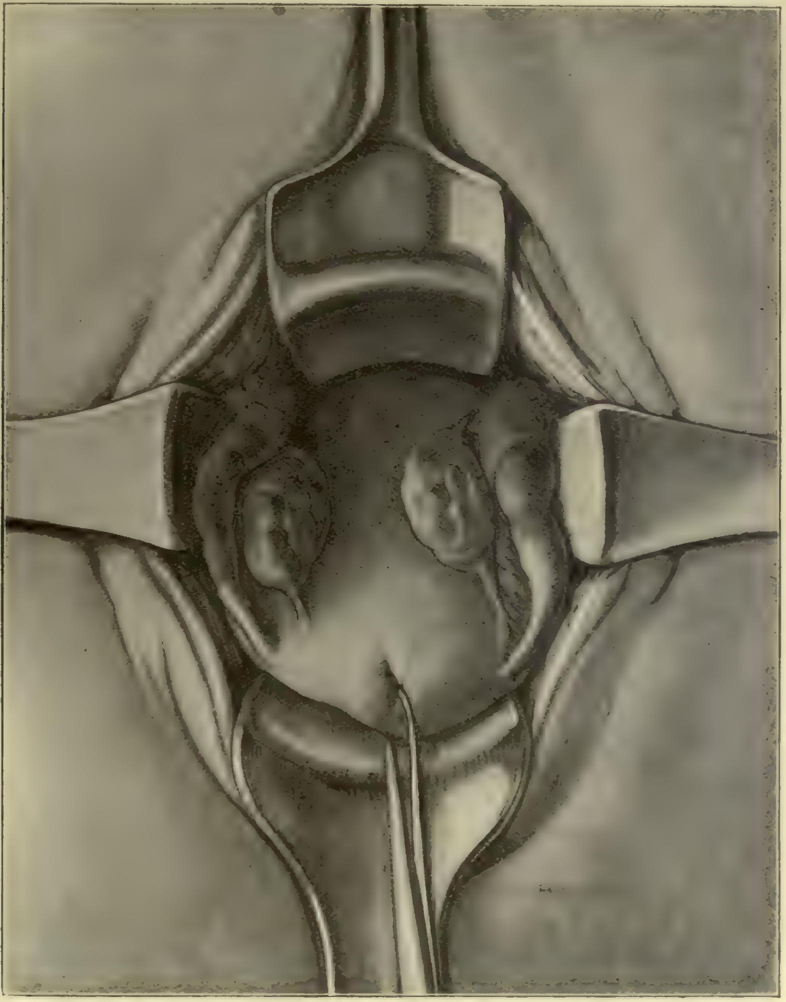

FIG. 235.—The uterus and normal appendages turned out through the anterior vaginal incision into the vagina.

The vesico-uterine fold of peritoneum is divided by a transverse incision (Fig. 234) one and a half to two inches long. At either end of the incision there may be some bleeding from the branches of the uterine vessels at the sides of the uterus.

Through the opening, the uterus, with or without the appendages, or either appendage alone, can be delivered into the vagina. In some cases this can be done with the fingers passed over the top of the fundus; in other cases by sharp hooks fastened to its anterior wall. It must be remembered always to push the cervix back into the posterior vaginal fornix, as the cervix and fundus uteri cannot both be drawn forward at the same time.

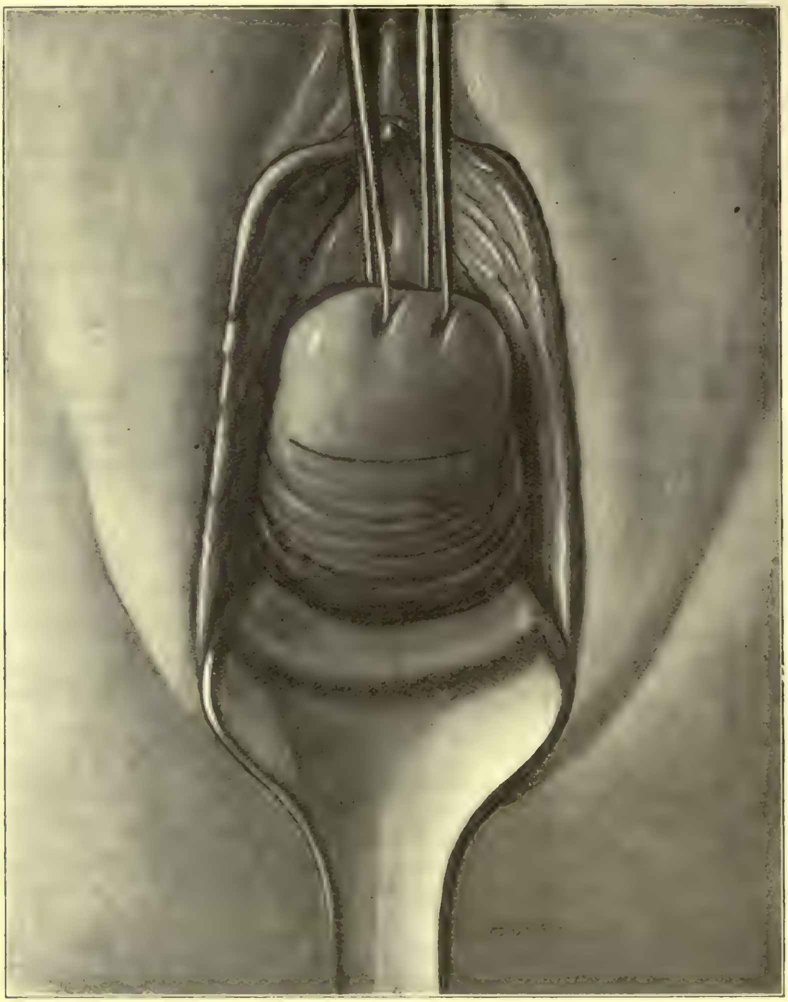

FIG. 236.—The line of a posterior vaginal incision.

After such operation as was indicated has been completed the wound is closed. The peritoneum is sutured with fine plain catgut. The bladder is replaced in its normal position and the vaginal flaps sutured with interrupted sutures of plain catgut. No drainage is necessary.

Technique of Posterior Vaginal Incision. The posterior lip of the cervix is seized with a pair of volsellum forceps and drawn forward. The posterior vaginal wall is seized by another pair two inches from the cervix and drawn backward. This puts the posterior vaginal wall on the stretch, and it should be divided transversely, preferably with the scissors, about an inch from the cervix (Fig. 236). If the incision is made too near the cervix the tendency is to strip the peritoneum from the posterior surface of the uterus and not to enter the peritoneal cavity. If, however, the incision is made too far from the uterus there is danger of injury to the rectum. After the incision has been made through the vaginal wall, the underlying tissue and peritoneum should be held with forceps and incised, and no attempt

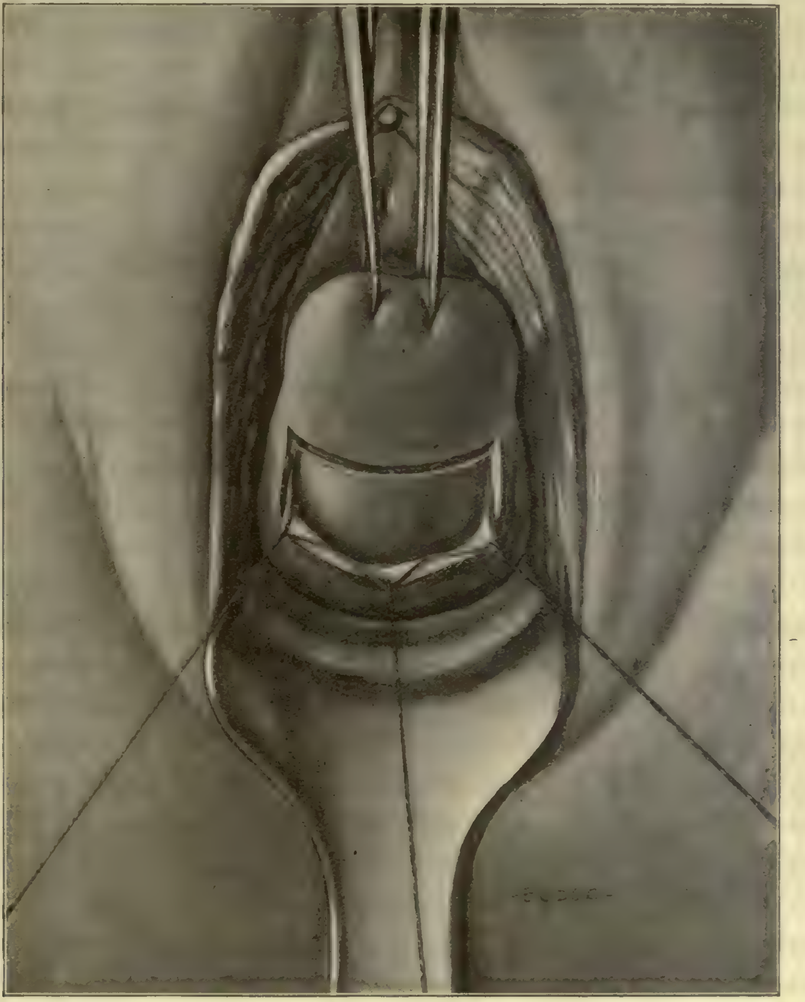

FIG. 237.—Posterior vaginal incision made showing the peritoneum exposed and opened.

should be made to tear them with the fingers, otherwise the peritoneum will be stripped from the surrounding organs and the landmarks obscured. After the peritoneal cavity has been opened the incision through the vaginal wall should be extended in each direction around the cervix as far as the utero-sacral ligament (Fig. 237). Additional room can be obtained by making a vertical incision downward from the middle of the posterior lip of this incision. This supplementary incision, however, is not usually necessary. When possible the peritoneum should be sutured to the vaginal wall along the posterior edge of the incision. This will keep the peritoneum attached to the vaginal wall, and thus hasten subsequent healing, and it will also tend to control bleeding from the cut edge of the vagina. There is usually no great bleeding from this incision, though there may be one or two small arteries at the extreme end on either side. If this incision has been made for diagnostic purposes, it is sutured with catgut at the end of the operation, bringing together first the peritoneal edges, and then the edges of the vaginal wound. The incision is, however, ordinarily made for drainage purposes, and of course then it is not sutured.

Accidents.—The only accident that is likely to occur in making the anterior vaginal incision is an injury to the bladder by not recognizing it when it is exposed. This accident is not frequent, and if it does occur the wound should be sutured at once with fine catgut sutures. A wound in the bladder usually closes without the formation of any fistula. The accidents which may occur in making the posterior vaginal incision are injury to the rectum, or to a coil of small intestine which may be in the pelvis, or to the ureter. These accidents, however, are not frequent. If the intestines which have been injured in a case where the posterior fornix has been opened for diagnostic purposes are free from adhesions, the intestinal wound may be sutured through the posterior fornix. Ordinarily it would be better to open the abdomen above before suturing the wound in the intestine to be sure that no further injury has been done. If the rectum has been injured, particularly in a case where the posterior fornix has been opened for drainage purposes, it is better to suture the wound through the posterior fornix, or, if this is not possible, to rely on the drainage. These cases almost invariably in the writer's experience have healed without leaving a permanent fistula. To open the abdomen from above in a case of this kind would be associated with considerable risk of peritoneal infection, undoubtedly more risk than if the case was dealt with by drainage alone.

Injury to the ureter has never happened in the writer's experience, but he has seen one such case in consultation. It was probably made by puncturing a pelvic abscess to one side of the middle line with a knife or with scissors which were too sharp-pointed. If no cutting with the scissors is done beyond the utero-sacral ligaments and only scissors with points somewhat blunt are used for puncturing abscesses, the ureter cannot be injured.

Vaginal Coeliotomy for Purposes of Diagnosis

A vaginal coeliotomy has distinct advantages over an abdominal incision in many cases for the purpose of diagnosis of pelvic lesions, as it is quickly made, produces practically no shock, and causes so little discomfort that, unless told when she recovers from the anaesthetic, the patient often does not know that the peritoneal cavity has been opened. Vaginal coeliotomy for purposes of diagnosis should be strictly limited to lesions located in the *cul-de-sac.* It has the disadvantage that through it no information can be obtained regarding abdominal organs other than those situated in the pelvis.

The posterior vaginal incision is the one that should be used for this purpose, as it is simple and can be quickly made, and is in the proper location for the investigation of conditions suitable for such an examination. The anterior vaginal incision is more complicated and has no advantages over an abdominal incision for purposes of diagnosis, as it requires longer time to make and necessitates displacing the bladder.

A posterior vaginal incision for purposes of diagnosis is indicated in the following conditions :

(*a*) *Ectopic Pregnancy.*—I use a posterior vaginal incision for diagnostic purposes in certain cases of ectopic pregnancy more frequently than for any other class of cases. There are cases of ectopic pregnancy with early rupture, in which it is not possible to palpate either the tube or clotted blood and in which the symptoms are not sufficiently pronounced correctly to diagnose the condition. In another class of cases of ectopic pregnancy there is a mass on one side of the uterus, and associated with it inflammatory symptoms making it difficult to determine whether the condition is an ectopic pregnancy or an inflammatory disease of the appendage. In these cases a posterior vaginal incision will enable a correct diagnosis to be made, and it is one that is least likely to do harm. If the case is found to be an ectopic pregnancy, the incision can quickly be closed with a couple of sutures and the operation completed through the abdomen. If the case is found to be an inflammatory disease of the appendage, it can be properly drained through the vaginal incision, and no further operation will be required. If, on the other hand, the abdomen is opened and an inflammatory lesion is found, the protecting barrier of adhesions may be broken down and the sacrifice of the appendage made necessary in order to prevent a peritoneal infection.

(*b*) *Carcinoma of the Uterus.* — A vaginal incision has been recommended to palpate the broad ligaments and to examine for enlarged glands in determining the operability of cases of carcinoma of the cervix or fundus uteri. I believe that this should never be done. To open the posterior fornix in a case of carcinoma of the cervix uteri is to open the peritoneal cavity past an area practically impossible to disinfect entirely, and it is associated with definite risk of peritoneal infection. The same is true in some cases of carcinoma of the fundus uteri. If there is any doubt about the operability of these cases after a vaginal examination under an anaesthetic, they are entitled to the thorough examination that only an abdominal incision can give.

(*c*) *Separation of Adhesions.*—This is an infrequent indication, but one that is sometimes recommended. If the appendages or uterus are adherent, it is usually better to open the abdomen from above, and, in addition to the separation of the adhesions, to do such additional operation as may be necessary to prevent the re-formation of the adhesions. There are, however, cases of adherent retroversion of the uterus associated with early pregnancy and possibly a history of early miscarriages, in which an abdominal operation is to be avoided, and a separation of the adhesions through the vagina and the retention of the uterus in place with a pessary are indicated.

Vaginal Coeliotomy for Inflammatory Diseases of the Appendages

There are three classes of operations for inflammatory disease of the appendages that may properly be performed through the vaginal route. They are as follows :

1. Drainage.
2. Resection of one or both ovaries or tubes.
3. Removal of one or both ovaries or tubes.

1. **Drainage.**—There is no vaginal operation which has given more satisfactory results in the writer's experience than the vaginal drainage of properly selected cases of pelvic abscess. By pelvic abscess is meant any collection of pus in the pelvis, whether it be a part of the peritoneal cavity shut off by intestinal adhesions, or between the layers of the broad ligaments, as may result from the infection of a ruptured ectopic pregnancy, or, as is by far more frequently the case, either in the tube as a pyosalpinx or in the ovary as an ovarian abscess. The exact location of the pus is often not easy to determine, and may not be essential to the proper treatment of the case. After the pus has been evacuated, it is best not to risk the separation of adhesions in order to determine the exact organ in which it originated.

In many pelvic conditions the operator may follow his personal inclination in deciding between an abdominal and a vaginal operation, but in cases of pelvic abscess suitable for drainage there is usually no such choice, and these cases, with rare exceptions, should all be approached through the vagina. The operation is simple, it can be completed in a few moments, and as complete relaxation is not necessary, it can be done under nitrous oxide anaesthesia. It causes little or no shock, and can therefore be done on patients in bad condition who would not survive an abdominal operation. As the free peritoneal cavity is not opened and the drainage is downward, the risk of extending the infection is not great.

The following are the cases of pelvic abscess which should be drained through the vagina :

(*a*) *The Peritoneal Abscess.*—Not infrequently following an operation for an acute appendicitis with spreading peritonitis, pus becomes sacculated between the coils of the intestines, forming a peritoneal abscess. The most frequent location of such an abscess, as the pus gravitates downward, is at the bottom of the pelvis. The same thing may occur if infection happens after any pelvic operation. If a ruptured ectopic pregnancy is not recognized and the pelvic haematoma becomes infected, a pelvic abscess in the *cul-de-sac* is the result. A peritoneal abscess formed in any of these ways or in any other manner, as long as it can be reached through the posterior vaginal fornix, is a proper case for vaginal drainage.

(*b*) *The Intraligamentous Abscess.*—Such an abscess may be the result of an ectopic pregnancy which has ruptured between the layers of the broad ligaments and subsequently become infected, or of the infection of an intraligamentous cyst, or of the direct infection of the cellular tissue of the broad ligaments, particularly following lacerations of the cervix and vagina during child-birth. The location is not a frequent one for a pelvic abscess, but it is particularly suited for vaginal drainage.

(*c*) *Abscesses of the Ovary or Fallopian Tube.*—These cases constitute the class in which a vaginal drainage is most frequently indicated. The choice between a vaginal and an abdominal operation for an abscess of the ovary or the Fallopian tube is influenced not only by the existing lesion but by certain social factors. The abdominal operation is more radical and it often leads to the sacrifice of both ovaries and tubes. It is associated with a greater mortality than vaginal drainage, and also with the risk of developing the nervous and mental symptoms that sometimes follow the removal of the ovaries. This is particularly true, as inflammatory diseases of the appendages are more frequent at the early age when the removal of the ovaries is more likely to be followed by nervous disturbances.

After the removal of appendages that have been the seat of inflammatory disease, patients are, as a rule, in excellent condition, cured and relieved of all pain and discomfort. Cases that are drained by the vagina are usually symptomatically cured, but there remain tubes and ovaries that are no longer normal, they are doubtless adherent, and beyond question such cases are more likely to have subsequent physical trouble, but less likely to have nervous disturbances, than those whose appendages have been removed. In some cases subsequent attacks of inflammation occur and the appendages may ultimately have to be removed. The vaginal operation is more conservative as neither the tubes nor the ovaries are removed; the risk even with a patient affected with a virulent infection is small, certainly much less than with an abdominal operation.

The abdominal operation therefore should be selected for the woman approaching the menopause, who no longer needs her appendages for possible conception, nor for the production of the internal secretion of the ovary, and particularly if the case is a chronic one with sterile pus and therefore with small risk of peritoneal infection even if the peritoneum is soiled in the removal of the abscess sac. The removal of the appendages through the abdomen is to be preferred to the drainage of them through the vagina for the patient whose social position is such that she must have the best possible health. That is, for the ward patient who must be able to do physical labour, there is an indication for the removal of the appendages, while for her more wealthy sister who is able to take more rest, and who also is more liable to the nervous disturbances following the removal of the appendages, the indication is toward a vaginal drainage. The vaginal drainage is to be selected for the young woman whose appendages are of great importance to her, also for the acute case, and for the exacerbation of the chronic case if an operation has to be done during this stage, as it is associated with a minimum risk of infecting the peritoneum.

To summarize: the abdominal removal of the appendages for inflammatory disease is indicated in the woman who is approaching the menopause and who has no physiological need for her appendages, especially in the chronic cases and in women who need the best possible health. Vaginal drainage of tubal and ovarian abscesses is indicated in the younger woman who needs her appendages, especially in the acute case, and in the case whose social position is such that strenuous physical exertion is not necessary.

Technique of Drainage of a Pelvic Abscess.—The posterior vaginal incision already described is ordinarily used. The writer has drained through the anterior vaginal fornix in an abdominal operation, but he has never done so in a vaginal operation, and it would be a most exceptional case in which it was indicated. A transverse incision about two inches long is made through the vaginal wall posterior to the cervix. If the abscess sac is in the *cul-de-sac*, it is not easy nor desirable to separate its wall from the peritoneum, and it is opened by pushing a pair of scissors directly into it. If the abscess is situated to one side of the middle line, scissors with sharp points should not be used, for fear of injury to the ureter. If pus is reached it will be shown by its running out around the scissors, and in this case the scissors are opened before they are withdrawn, so that the opening will be sufficiently large for proper drainage. If the scissors are withdrawn closed the opening will be too small for proper drainage, and furthermore after some pus has escaped and the sac has collapsed it will be difficult to find the opening into it. If, however, pus is not reached, the scissors should be withdrawn

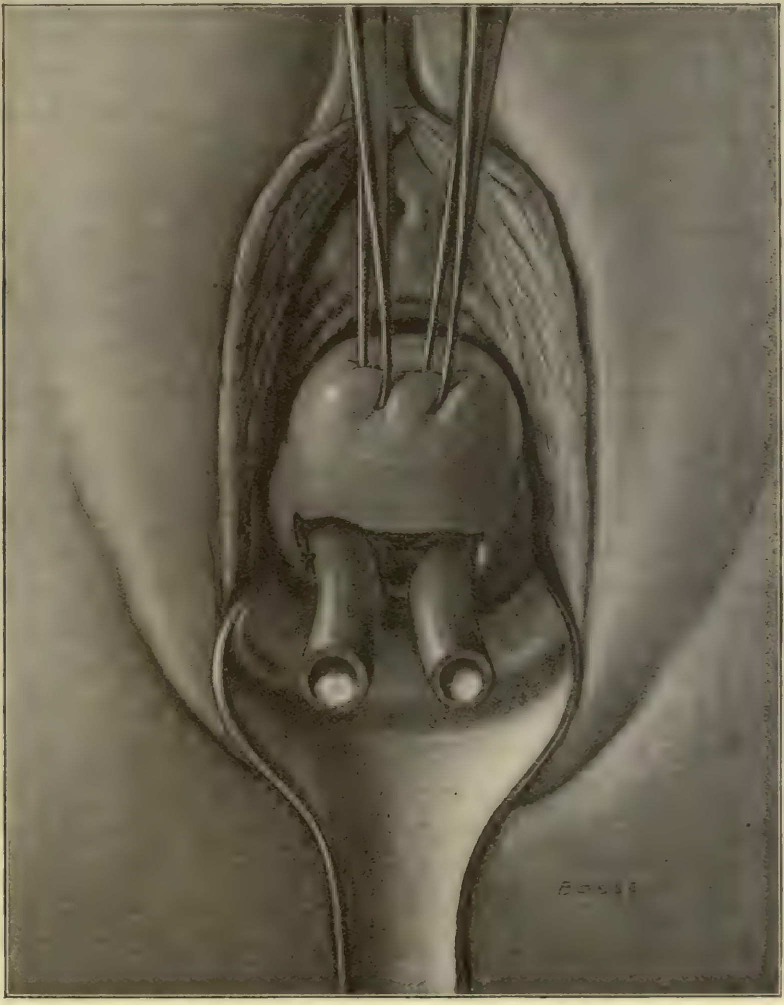

FIG. 238.—Posterior vaginal incision, drainage tubes in place.

closed and further digital examination made, otherwise possible damage may be done.

If the abscess sac is situated higher in the pelvis, it is necessary to enter the peritoneal cavity to reach it, and there is some increased risk of peritoneal infection. The risk, however, is not great, as probably the general peritoneal cavity higher up is closed off, and furthermore it would quickly absorb the small amount of pus that might reach it. There is also some increased risk of injury to the intestines, though this has never occurred in the writer's experience. After the peritoneal cavity has been opened through the posterior vaginal incision, the finger is passed in definitely to locate the abscess. Along the finger as a guide, the scissors are inserted and pushed into the abscess, and, for the same reasons given above, are opened before they are withdrawn. After the pus from the opened abscess has been cleaned out as described below, further digital examination is made to determine, as is often the case, if there are other abscesses present to be drained. If they are found they are opened as has been described. In some cases the abscess is opened directly with the finger, but this method is to be avoided, as the abscess may rupture upward from the pressure on it and flood the peritoneal cavity with pus. After all the abscesses have been opened no further manipulation should be made, as by so doing intestinal adhesions may be separated and the general peritoneal cavity exposed. This should be avoided if possible.

If it is certain that the abscess cavity is shut off from the peritoneal cavity, it should be irrigated with a non-toxic fluid such as sterile water or normal salt solution. Neither strong antiseptics nor great pressure with the irrigation should be used, as there may be an unsuspected opening into the peritoneal cavity. If it is known that the peritoneal cavity has been opened, then it is better to sponge out the pus and not to irrigate at all. With a free opening at the bottom of the abscess cavity there is little chance of upward extension of the infection.

It is necessary that the opening through the vaginal wall and into the abscess cavity should be kept open until the abscess cavity is entirely healed. This is ensured by making a liberal incision through the vaginal wall, by suturing its edges to the peritoneum, or even to the wall of the abscess itself if it is possible to do so.

If the abscess is low in the pelvis, that is, in contact with the vaginal wall, it should be packed with sterile gauze. It should not be packed firmly, as it is desirable to allow the intra-abdominal pressure to close down the cavity as rapidly as possible, and this is prevented if it is packed too tightly. If the abscess is higher, that is, if there is a definite interval between the vaginal wall and the abscess cavity, it is better to use one or two soft rubber drainage-tubes of a large size (Fig. 238), otherwise the abscess cavity may be shut off before it is obliterated, necessitating a second operation.

The after-treatment of these cases is simple. If gauze has been used, it should be left in place, if possible, from four to six days, otherwise it will cause considerable pain in removing it. If, an hour or two before the gauze is to be removed, the patient is given a vaginal douche, the gauze will have become soaked and it will come away with less trouble. It will also assist if the gauze is gently twisted first one way and then the other to loosen it instead of drawing it directly out. It is well to follow these suggestions, otherwise considerable pain will be given to the patient. If a considerable amount of gauze has been used it should be partly removed on the third or fourth day and be entirely removed by the fifth or sixth day. If after the first twenty-four hours there is a rise of temperature, the gauze should be loosened or removed, as it probably indicates that there is imperfect drainage. This will allow the cavity to contract more rapidly than if the gauze is left longer in place. After the gauze has once been removed it is not practicable to replace it. To do so gives the patient considerable pain and does not really improve the drainage. There is at this stage a cavity in the pelvis with an opening into the vagina which tends to contract, and careful attention should be given that this opening is kept as widely dilated as possible. Every one or two days this opening should be dilated either with the fingers or with a metal dilator, so that it will not close before the abscess cavity above is healed. With a wide opening no irrigation of the cavity is necessary, and it is best to avoid it. Later, when the opening is smaller, if the drainage is not satisfactory an occasional irrigation may be necessary.

If rubber drainage-tubing has been used it should not ordinarily be disturbed for four or five days. At the end of that time it should be shortened so that it extends only a short distance through the vaginal opening. If the quantity of pus is large a mild irrigation under low pressure may be used to ensure the patency of the tubes.

End-Results of Vaginal Drainage.—Symptomatically most of these cases are cured with the vaginal drainage, but it is natural to expect that there will be permanent adhesions about the organs diseased. If the abscess was in the tube, that is, if it was a pyosalpinx, both the uterine and the fimbriated ends were probably occluded, and it is doubtful if the patency of the tube is restored by the drainage and cure of the abscess. It follows, if both tubes were involved in this way, that the patient would remain sterile.

Some cases will require a second vaginal operation on account of a reaccumulation of pus. This is due to the high location of the abscess and too early closure of the track from the abscess to the vagina, or the closure of the opening into the vagina before the abscess cavity has healed. A reaccumulation of pus should not be interpreted as a failure of the vaginal drainage and as an indication for opening the abdomen with the removal of the appendages, as another vaginal drainage may effect a cure.

In another class of cases the abscess is cured, but there remains a chronically inflamed or adherent appendage which is the cause of constant or recurring attacks of pain, sufficiently severe to warrant an abdominal operation with the possible removal of the diseased organs. An abdominal operation with opening or resecting the tubes may be indicated for sterility.

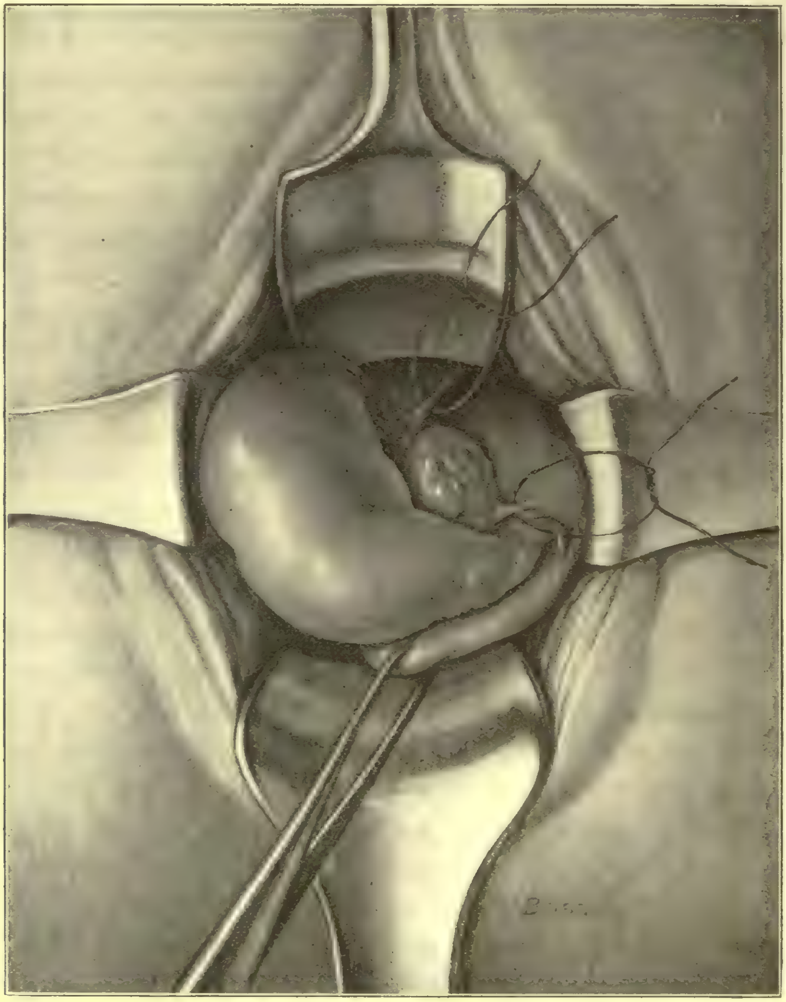

FIG. 239.—Pyosalpinx turned out through anterior vaginal incision, sutures applied to the infundibulo-pelvic and utero-ovarian ligaments.

In the writer's experience most cases are symptomatically cured except for the sterility and need no further operation. Cases that require a second vaginal drainage are considered as having received faulty after-treatment. The cases requiring a subsequent abdominal operation are in the great minority.

2. Removal of Uterine Appendages through the Vagina.—This operation should

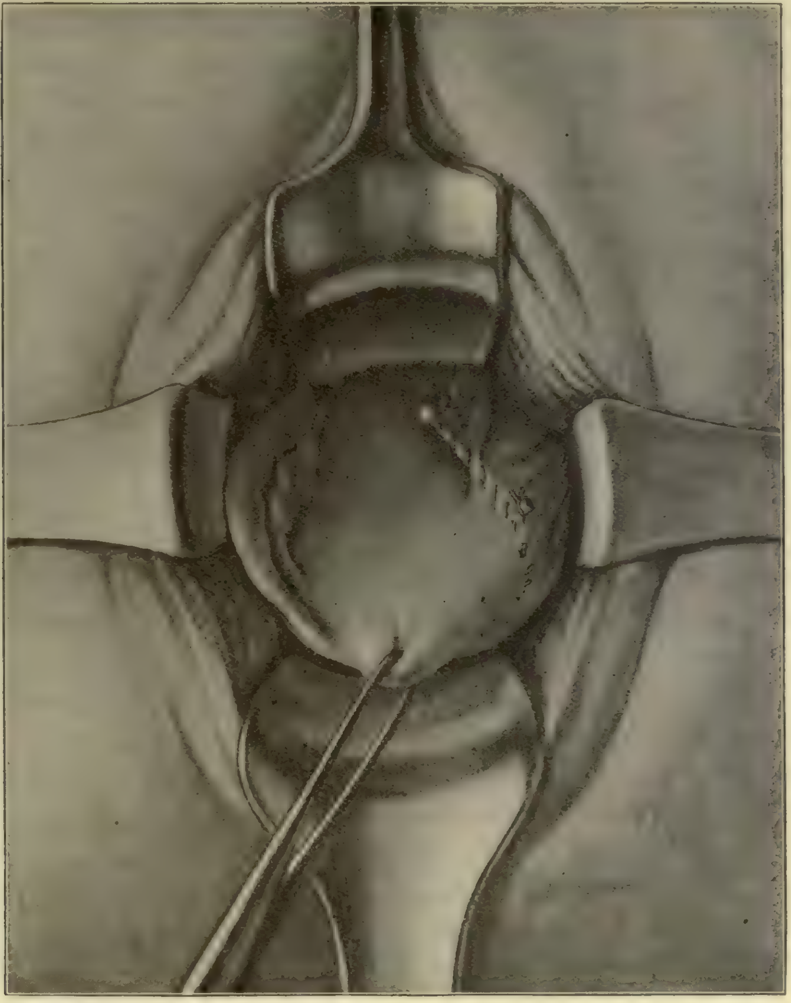

Fig. 240.—The same after the appendage has been removed.

with few exceptions be performed through the anterior and not through the posterior vaginal fornix. It should only be done when the diseased appendages are limited in extent, both as to size and adhesions, and when the anterior vaginal wall is relaxed. I personally remove uterine appendages through the anterior vaginal fornix only when they are found diseased when the peritoneal cavity has been opened in doing an operation for repair of relaxation of the anterior vaginal wall. If the operation is not a simple one and if the anterior vaginal wall is not relaxed, it is easier and is associated with less risk of injury to neighbouring organs to open the abdomen and operate under more direct view.

Technique.—The anterior vaginal incision previously described is used. The cervix is pushed toward the posterior vaginal fornix and the fundus is drawn forward with volsellum forceps and delivered into the vagina. The adhesions about the appendages are separated and first one and then the other appendage is delivered through the vaginal incision (Fig. 239). The infundibulo-pelvic ligament is ligated and divided, and the appendage is cut from the broad ligament and the uterine portion of the tube is excised. All bleeding points are caught and ligated, and the two layers of the broad ligaments are sutured together (Fig. 240). The operation as described is done with the parts in the vagina and within easy reach. Usually the cases of diseased appendages suitable for removal through the vagina do not require any drainage. If drainage is necessary it should be accomplished by a separate opening in the posterior vaginal fornix or by the removal of the uterus, as the anterior vaginal incision is not suitable nor in the right position for proper drainage. Such operation as may be indicated is done on the anterior vaginal wall, and the operation is completed.

3. Resection of Uterine Appendages through the Vagina.—As in the former class of cases, the operation is ordinarily done through the anterior vaginal fornix and should be limited to simple resections in cases which have large vaginae. The most frequent cases in which the author resects appendages through the vagina are those which it is necessary to sterilize preliminary to doing any vaginal fixation or interposition operation for cystocele. Usually the conservative operations on the appendages should be done through the abdomen.

Technique.—The appendages are exposed, as has been described in the operation for the removal of the uterine appendages. After such operation as indicated has been done, the uterus and appendages are returned into the abdomen and such additional operation as planned on the vagina is completed.

VAGINAL COELIOTOMY FOR ECTOPIC PREGNANCY

Indications.—There are three classes of cases of ectopic pregnancy that may properly be treated by vaginal section. They are :

1. Unruptured Ectopic Pregnancy.
2. Ruptured Ectopic Pregnancy with a small haematocele.
3. Infected Ectopic Pregnancy.

1. If the *unruptured ectopic pregnancy* makes a small tumour and the vagina is large, especially if there is some prolapse of the uterus, making the access to the pelvis easy, the vaginal operation may be selected. If, however, the tumour is of considerable size or if the vagina is small, the abdominal route is preferable. The writer usually selects the abdominal route as being more easy of execution, leaving a cleaner operation field than the vaginal incision.

2. The *ruptured* ectopic pregnancy with a small haematocele is a more proper condition to approach through the vagina than the unruptured ectopic pregnancy. It is often difficult to distinguish these cases from the inflammatory diseases of the appendages, and they are opened through the vagina under this mistaken diagnosis. If the haematocele is larger than an orange, it is unwise to rely on the vaginal drainage alone without opening the abdomen from above, because it is not possible to remove all the blood-clots through the vaginal incision, and if the cavity that remains is too large it is sure to become infected before it is healed. These cases therefore would better be opened through the anterior abdominal wall, the blood-clots largely removed, and the cavity obliterated by sufficient separation of adhesions to allow the intestines to fill the pelvis. If there is no infection such a case needs no drainage, and is safer without it, as drainage may lead the way for infection. If there has been no infection, a few scattered blood-clots will quickly be absorbed and will therefore do no harm. Large blood-clots, especially if shut in by adhesions, become absorbed slowly, and frequently get infected from the intestines before sufficient time has elapsed for them to disappear entirely. It is therefore best to remove all large blood-clots as thoroughly as the condition of the patient will allow.

There is no doubt that there are many cases of ectopic pregnancy with rupture of the tube or with a tubal abortion and the formation of a small haematocele, which will be absorbed and entirely disappear without operation. Neither is there any doubt that many such cases occur which are never diagnosed. The amount of bleeding is so small that no haematocele or only a small mass is felt, which disappears with a few days' rest in bed, and the correct diagnosis is never made. It is my belief, however, that a vaginal incision with the removal of the blood-clots ensures greater safety and a more rapid and complete convalescence than no operation. The general peritoneal cavity will be shut off by adhesions, the blood-clot will often be broken down and of a fluid consistence, and with an opening in the posterior vaginal fornix it can easily be evacuated. To operate on these cases through the abdomen is associated with greater risk than through the vagina. An operation through the vagina is associated with a small risk and a short convalescence, and is the preferable route.

3. The cases of *infected ectopic pregnancy* are ordinarily more safely treated by

vaginal incision alone. This is particularly true in the early months of the pregnancy when the original haematocele is relatively small.

If the case has advanced to the formation of a placenta and a tangible foetus, then, assuming that the patient is not in an extremely bad condition, the abdominal route should be selected, even though the case is infected. It is safer to open the abdomen and remove foetus and placenta, leaving a relatively clean field, than to drain through the vagina, removing the placenta only partly or not at all; this leaves an operative field sure to become more infected, producing a severe toxaemia by which the patient may be overcome. If the patient is already in a bad condition it is better to drain through the vagina and wait, with the hope that the general condition of the patient may improve, allowing a more complete operation to be performed later.

Technique of Vaginal Coeliotomy for Unruptured Ectopic Pregnancy.—The diseased tube may be approached through the anterior vaginal fornix or through the posterior vaginal fornix, as the case indicates. If the tube is adherent in the *cul-de-sac* of Douglas and the vaginal route is selected, then the tube should be reached through the posterior fornix, the blood-clot enucleated, but no attempt made to remove the tube through the posterior fornix. If the diseased tube is situated higher, and especially if still movable, it may be reached through the anterior vaginal fornix. This operation through the anterior vaginal fornix should not be undertaken unless the relative size of the uterus and of the vagina allow it. If the uterus is large or the vagina is small, it is not easy properly to expose the appendage, and such cases should be operated upon through the abdomen and not through the vagina. The tube should be delivered into the vagina, and either removed entirely, or incised and returned to the abdomen after the blood-clot has been enucleated.

Operation through the Posterior Vaginal Fornix.—The posterior vaginal incision previously described is used. If the diseased tube is low in the *cul-de-sac* a pair of pointed scissors can be shoved into the tumour mass, opened, and withdrawn without closing. This will tear an opening into the tube through which the blood-clot can be evacuated. If the tube is situated higher, the free peritoneal cavity must be opened before the tube itself is reached. This is somewhat more difficult, and care must be taken not to injure the intestines.

After the blood-clot has been evacuated the cavity should be sponged, and dry-packed lightly with sterile gauze which should be left in place four or five days and then removed. At the end of this time the cavity will have contracted, and it is unnecessary to replace the gauze packing. Care should be taken that the opening through the vaginal wall is not allowed to close before the cavity above it is obliterated.

Operation through the Anterior Vaginal Fornix.—The anterior vaginal incision previously described is used. Through this incision the tube is delivered by itself, or the uterus together with the tube can be turned out into the vagina. The latter procedure gives better access to the tube but requires more room, and in many cases it would therefore be more difficult. If, however, the vagina is large, or there is any prolapse of the uterus, it can usually be done without difficulty. It must be remembered as the fundus is turned forward, that the cervix must be pushed backward into the posterior fornix, as the fundus and the cervix of the uterus cannot both be drawn forward at the same time.

After the tube containing the ectopic pregnancy has been delivered into the vagina, it may be removed entirely or it may be incised, and, after the gestation products have been enucleated, the incision may be sutured and the tube preserved, as the individual case demands. If the tube and ovary of the opposite side are normal, then the diseased tube should be removed entirely. The same is true if, on account of the age of the patient or the number of living children that the patient has, further pregnancy is undesirable. There is no question that a tube once the seat of an ectopic pregnancy is a diseased tube, and if it is retained it may cause pain and subsequently interfere with the best health of the patient. It should therefore be removed unless there is reason for preserving it. If the other tube has been previously removed, or if it is diseased, particularly if the patient desires more children, then the tube obviously should be saved. After the operation on the tube is completed, the uterus and the appendages are returned to the abdomen, the wound in the peritoneum is sutured, the bladder drawn down into its normal place, and the vaginal wound closed without drainage.

Ruptured Ectopic Pregnancy with a small Haematocele.—There is no doubt that a tubal pregnancy sometimes ruptures between the layers of the broad ligament, but that it is an unusual condition is the experience of all surgeons. Ordinarily the rupture in the tube is in the general peritoneal cavity and the blood gravitates to the bottom of the *cul-de-sac* of Douglas, where it is shut off from the general peritoneal cavity by adhesions between the coils of the intestines. Free blood higher in the abdomen is in smaller masses and is quickly absorbed.

If the rupture in the tube is recent, and bleeding is still going on or there is a chance of its recurring, then it is better and quicker to open the abdomen above the pubes, remove or resect the tube as the case requires, remove the larger part of the blood-clots, and close the abdomen without drainage. There are cases in which the rupture is of such age that the possibility of present or subsequent bleeding is slight, and in which there is a small haematocele shut off by adhesions. Beyond doubt many of these cases would recover without operation, but it is my belief, however, that the convalescence is quicker and more sure if the blood-clot is removed.

Technique.—The posterior vaginal incision is used. The peritoneum should be opened with the knife or scissors, and care should be taken not to attempt to tear through with the finger as the peritoneum is easily pushed off the rectum and will be more difficult to locate. Opening the peritoneum ordinarily opens directly into the haematocele. The blood-clots are evacuated with the finger, the free blood sponged out, and the cavity packed lightly with plain sterile gauze.

Infected Ectopic Pregnancy.—These cases clinically are practically the same as a pelvic abscess, in fact frequently they are the early stage of such a condition, and should be treated as such. If the case has advanced beyond the early months of gestation with the formation of a placenta and definite foetus, it may be necessary to open the abdomen above the symphysis in order to remove them and have a clean operative field. In the larger number of cases, however, the condition results from infection with the colon bacillus (from the intestine) of a haematocele formed by an early rupture of the tube or by a tubal abortion. If these cases are operated upon from above the pubes, the protecting barrier of intestinal adhesions must be broken down with attending risk of a general peritoneal infection. If approached through the vagina the barrier is not disturbed, and the risk of peritonitis is small.

Technique.—This is the same as for pelvic abscess. The peritoneal cavity is opened through a posterior vaginal incision and the broken-down blood-clot readily flows out. There is some difference of opinion among surgeons whether these cavities should be irrigated or not. It is my custom, if the intestinal adhesions have not been separated, to irrigate them with a normal saline solution under low pressure. The cavity is then cleaner and there is less culture material for the mixed infection that is likely to be present before the cavity is entirely closed. Either soft rubber tubing or plain gauze can be used to maintain drainage until the cavity has so contracted that it is no longer necessary.

VAGINAL COELIOTOMY FOR OVARIAN CYSTS

The abdominal is the route of election for the removal of ovarian cysts, and the vaginal operation should be done only for definite indications.

Disadvantages of the Vaginal Route.—(*a*) *Infection of Wound.*—It is not possible from an examination of a patient to determine positively if a cyst is benign or malignant or is a dermoid. As there is definite risk of implanting cancer cells in fresh tissue if a malignant cyst is tapped, and as there is danger of soiling the peritoneum if an attempt is made to empty a dermoid cyst, some operators make an abdominal incision long enough to remove them without evacuating any of their contents to avoid these accidents. Practically all ovarian cysts that are removed through the vagina are first tapped to reduce their size so that they can be removed through the vaginal incision, and as the cyst wall is frequently torn in drawing it out through the vagina, there is always definite risk of soiling the pelvic peritoneum and the vaginal wound with the cyst contents.

(*b*) *Limited Space.*—If the cyst is large and composed of a number of sacculi, it is difficult to puncture each compartment with the trocar and sufficiently evacuate the fluid to allow the cyst wall to be drawn through the vaginal opening. As it is not possible properly to expose each compartment of the cyst, there is danger of perforating the main cyst wall with possible injury to the intestines or soiling of peritoneum.

(*c*) *Intestinal Adhesions.*—It is not possible to determine, previous to operation, the presence or extent of adhesions that have formed between the cyst and intestines or other abdominal organs. It is not easy to separate extensive adhesions through the vaginal incision, and injury may be done that could have been avoided through the larger abdominal incision. If an attempt is made to remove an ovarian cyst through the vagina and extensive adhesions are found, or if the adhesions present cannot easily be exposed to direct sight, it would be better to discontinue the vaginal operation and to remove the cyst through the abdomen, or in certain cases, as described later, to drain a portion of the sac through the vagina.

Indications for the Vaginal Route.—Ovarian cysts may be either removed or drained through the vagina.

Indications for Removal.—1. Cysts that are of small or moderate size and are exposed during the course of other vaginal operations. For example, if during an operation for prolapse of the uterus when the anterior fornix is opened such a cyst is present, it should be removed through the vaginal incision.

2. Simple ovarian cysts not over four or five inches in diameter, which are believed to contain only a thin fluid and to be free of adhesions. This characteristic of the tumour should be confirmed by digital examination after the vaginal incision has been made. The usual indication of a vagina of ample size obtains here as in other vaginal operations.

It is my personal belief that most of these cases, even with the restrictions given, would better be operated on by the abdominal route. The cyst that is easy to remove through the vagina is even more easily removed through an abdominal incision. Accidents, such as haemorrhage, soiling of peritoneum, and injury to surrounding organs, are more easy to avoid through an abdominal wound than through the more restricted field of a vaginal incision.

3. Ovarian cysts that are found deep in the pelvis during the latter months of pregnancy or at confinements. If such a growth is high in the abdomen, it is not a case for vaginal but for abdominal removal. If such a tumour is found during the early months of pregnancy it can easily be removed through the abdomen and usually without interference with the pregnancy. To remove through the abdomen a tumour situated in the pelvis behind a large pregnant uterus would require a long incision and such manipulation of the uterus that a termination of the pregnancy would be probable. If the tumour on vaginal examination proved to be malignant, its removal through the abdomen would be imperative.

The cases of ovarian cysts which make up this third group are the ones in which the indication for the vaginal route is the strongest.

Indications for Drainage.—1. A benign ovarian cyst discovered in the pelvis during the latter months of pregnancy or at a confinement, the removal of which through the vagina is not feasible on account of adhesions or other causes, should be drained through the vagina.

2. Benign ovarian cysts, not over three inches in diameter, in women to whom the preservation of the ovary is of special value, may be drained through the vagina. The writer recently had under observation a woman inclined to obesity, still in her early menstrual life, and one of whose ovaries had been removed at a previous operation, with a simple cyst about three inches in diameter in the remaining ovary. This cyst was drained through the vagina and the patient symptomatically cured. The cyst may recur, but for the time being she retains her menstrual and reproductive functions, and has not the risk of further increase in weight from the removal of all ovarian tissue. The advantages of retaining the ovary outweigh the risk of a subsequent drainage if necessary.

Relative Advantages of the Anterior and Posterior Vaginal Incisions.—The anterior vaginal incision is more extensive and requires more dissection, but gives more room and better access than the posterior vaginal incision. I only use the anterior vaginal incision for the removal of ovarian cysts when the incision is already made for other vaginal operation such as for prolapse of the uterus. The posterior vaginal incision is more simple, and as most cysts suitable for the vaginal operation are located posterior to the uterus in the *cul-de-sac*, it is the incision usually employed for their removal. It is the only vaginal incision that should be used for the removal of ovarian cysts associated with pregnancy and for the cases which are to be drained.

Technique of Vaginal Removal of an Ovarian Cyst.—The cyst may be exposed through the anterior or posterior vaginal incision. If the cyst does not present directly at the vaginal opening it should be manipulated bi-manually until it does. Before any attempt is made to remove the cyst, it should be carefully examined with fingers inserted through the vaginal opening to determine the characteristics of the tumour. If it is found to have intestinal or other adhesions, if it is found to be malignant or dermoid, it would be better to discontinue the attempt to remove it through the vagina. If the vaginal operation is continued, the cyst is held against the vaginal incision either by pressure from above or by clamps fastened to its wall and punctured with a trocar. As the fluid is withdrawn, the traction on the clamps

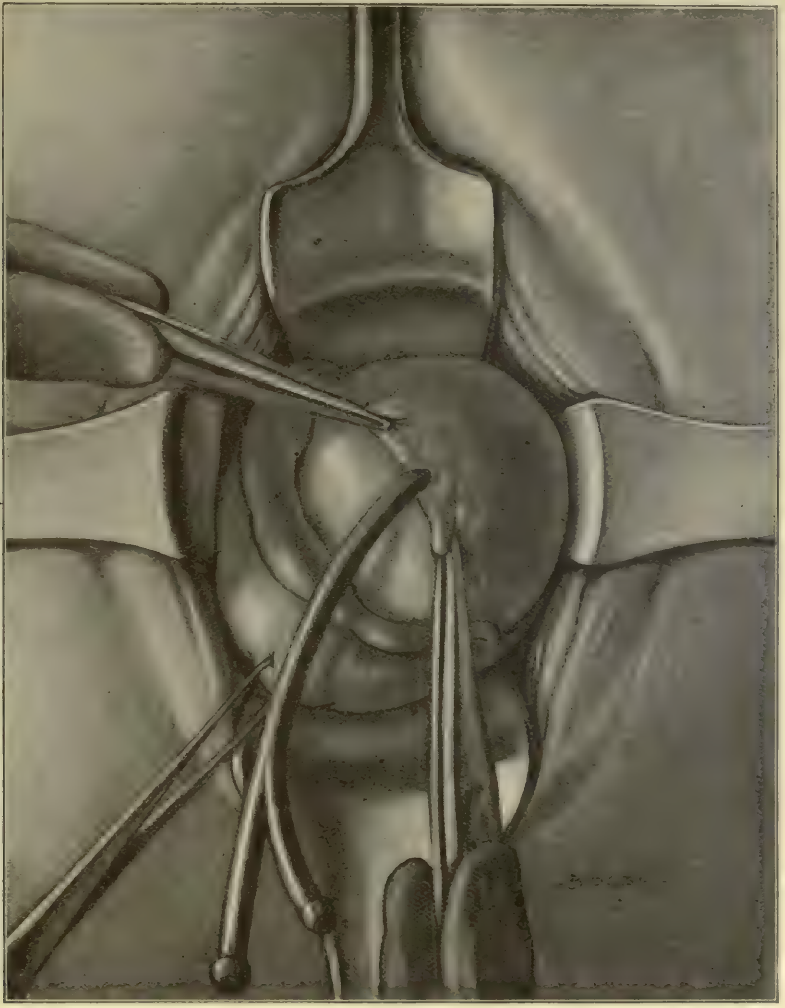

FIG. 241.—Ovarian cyst drawn out through anterior vaginal incision.

fastened to it and the pressure from above deliver the cyst wall into the vagina. The pedicle is usually easily reached and is ligated with catgut and divided. The vaginal wound is closed without drainage.

Technique of Vaginal Drainage of Ovarian Cyst.—The posterior vaginal incision is always used. If the cyst is movable, it should be first brought to the vaginal opening, otherwise it should be evacuated where it is situated (Figs. 241 and 242). The contents are first evacuated with a trocar. The opening is then enlarged, the cyst cavity sponged dry and packed with gauze. The gauze packing should be left in place long enough to incite sufficient inflammatory reaction to destroy the lining

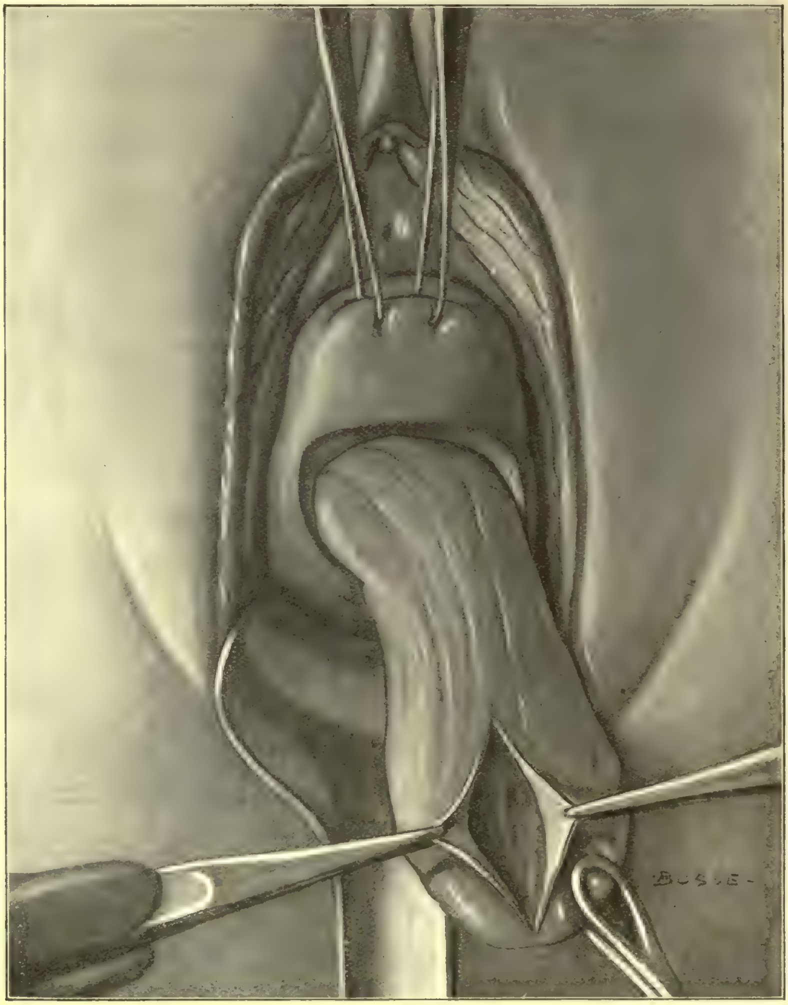

Fig. 242.—Ovarian cyst evacuated and drawn out through the posterior vaginal incision.

epithelium of the cyst and so prevent its refilling. If necessary the packing may be taken out and replaced.

If the cyst is a small one, and it is drained with the desire to preserve the ovary, no attempt should be made to remove any part of its wall. If, however, the cyst is a large one, and it is drained because it is not feasible to remove it on account of existing pregnancy, the cyst wall should be diminished as much as possible. Such part of the cyst as is movable and can be drawn into the vagina should be cut away and removed. As the cyst that is drained is sure to become infected before it is healed, and if it is large the amount of absorption may be sufficient to endanger the

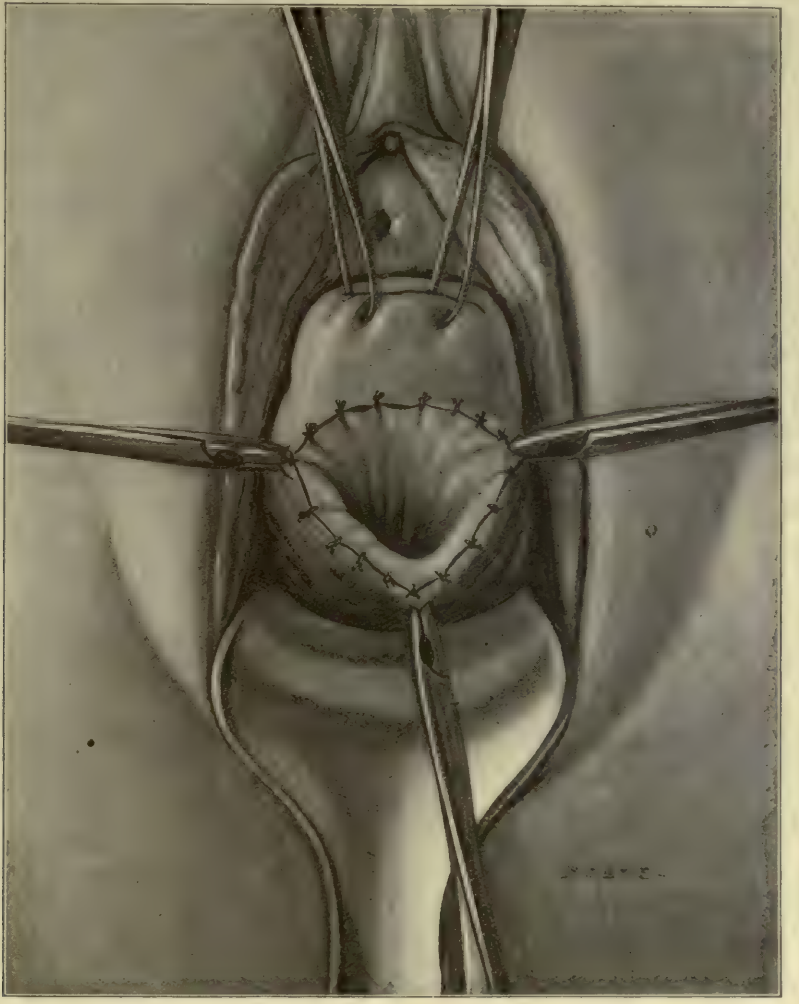

Fig. 243.—Ovarian cyst drawn out in part with part of cyst wall sutured to posterior vaginal incision.

life of the patient, its size should be reduced as much as possible by removing such part of the cyst wall as can be brought within reach. Bleeding from the cut edge of the cyst wall and possible soiling of the peritoneum are prevented by suturing the cut edge to the edges of the vaginal opening (Fig. 243).

The subsequent treatment of these cases is the same as described under drainage of inflammatory diseases of the appendages.

A cyst posterior to a pregnant uterus may sometimes be tapped instead of drained to remove the obstruction to delivery. Such a procedure is more quickly done and there is little risk of infection.

VAGINAL MYOMECTOMY FOR FIBROMA UTERI

In this section vaginal myomectomy only will be considered. For a description of abdominal and vaginal hysterectomies and abdominal myomectomy see pages 459, 471, 541.

General Indications for Myomectomy.—(*a*) *Mortality.*—With the exception of small fibromata which give no symptoms but are removed because found in the course of some other operation, a myomectomy is a more difficult operation and is associated with a higher mortality than a hysterectomy. A myomectomy should therefore be done only if there is a definite indication for the preservation of the uterus. There are two real reasons for preserving the uterus in the presence of a fibroma. One is to retain the reproductive function, the other to retain the menstrual function and to avoid the mental and nervous symptoms which arise if it is too early interrupted.

(*b*) *Reproductive Function.*—If both ovaries or both tubes have been removed, or if the patient has passed the child-bearing period, a myomectomy will not preserve the reproductive function and should not be done. Statistics show that a myomectomy in a woman over forty years of age is rarely followed by pregnancy. The same is true regarding a single interstitial fibroma over five inches in diameter or numerous small interstitial fibromata. This is due probably to permanent changes in the endometrium, and in general the nearer the tumours are to the endometrium the worse is the prognosis as to subsequent pregnancy. Naturally the reproductive function is of less value to the woman who has a number of children than to the one recently married.

(*c*) *Menstrual Function.*—If both ovaries have been removed there is nothing to be gained by preserving the uterus, and a myomectomy is not indicated. The earlier the age of the patient the more important it is to save the menstrual function. As a woman approaches the menopause, the risk of mental or nervous disturbances following the removal of the uterus lessens and there is correspondingly less reason for saving the organ. In the neurotic, highly strung woman, particularly if there is any trace of insanity, it is important not permanently to stop menstruation. The same is true of a woman who is inclined to obesity. While the removal of the uterus is not usually followed by special increase in weight, this happens sometimes, particularly in the woman already obese. These three factors, the higher mortality and the relative value of the menstrual and reproductive functions, must be considered in deciding between a hysterectomy and a myomectomy.

Indications for Vaginal Myomectomy.—There are two real factors to be considered in regard to myomectomy through the vagina, namely the relative size of the uterus together with the tumour, and that of the vagina. Through the small vagina of an unmarried woman a myomectomy should rarely be attempted, for while it is possible to enlarge the vagina by a paravaginal incision, it is better to do an abdominal myomectomy. Through the vagina of a woman who has had a number of children, it is usually easy by turning the uterus out into the vagina to remove small fibromata. The larger the vagina and the greater the prolapse of the uterus and vaginal wall, the more extensive is the myomectomy that can properly be done through the vagina.

Not including cervical polypi, the removal of which is very simple and will not be considered in this chapter, fibromyomata uteri which may be treated by vaginal myomectomy may be divided into two classes, depending on their location in the uterus and requiring different types of operation. They are (1) submucous fibromyomata which are removed from the inside of the uterus by incision through the endometrium ; and (2) interstitial and subperitoneal fibromyomata which are removed from the outside of the uterus by incision through the peritoneum.

Technique of Vaginal Myomectomy for Submucous Fibromyomata Uteri.—If the tumour is pedunculated, it may be grasped with the proper instrument passed through the dilated cervix and by twisting first in one direction and then in the other with gentle traction, the pedicle can usually be severed and the tumour freed. If the pedicle is too large to be entirely twisted off it can be partly cut with the scissors and then twisted off. Care must be taken not to make too great traction on the tumour, otherwise the uterus may be inverted or its wall torn. In no case in the writer's experience has there been haemorrhage following the removal of a fibromyoma uteri in this manner sufficient to require treatment. It is conceivable, however, that there might be. It could be easily controlled by packing the uterus.

If the submucous fibroid is not pedunculated, then it is necessary to have more definite and free access to the tumour before removing it. In exceptional cases this may be done by simply dilating the cervix. Usually, however, it can only be accomplished by incising the anterior lip of the cervix and a part of the anterior wall of the uterus.

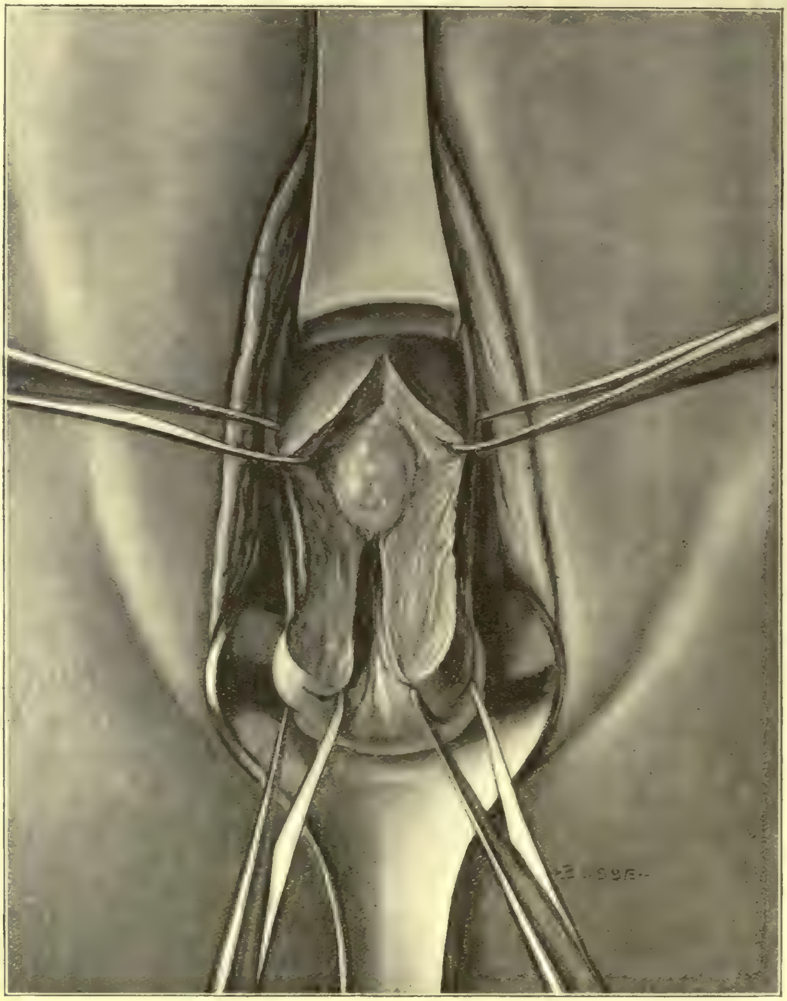

FIG. 244.—Uterus divided, exposing the interior of the uterus for the enucleation of submucous fibroids.

This is done in the following manner: The anterior lip of the cervix is seized by two pairs of single volsellum forceps, one on each side of the middle line, and drawn down towards the vulva. The bladder is exposed through the anterior vaginal incision as previously described, and is separated both from the vaginal wall and from the anterior surface of the uterus. The utero-vesical fold of peritoneum may or may not have to be opened. The anterior lip and the anterior wall of the uterus are incised into the uterine canal as high as the peritoneal reflection. This will be just above the internal os of the uterus and will give sufficient room for the removal of the tumours in the lower part of the uterine cavity. If additional room is needed the utero-vesical fold of the peritoneum is opened, and a second set of volsellum forceps are placed on the edge of the uterine incision above the first set, and the uterus drawn more into view. To facilitate drawing the fundus uteri down and forward, the cervix must be pushed back toward the posterior vaginal fornix. The incision in the anterior uterine wall is extended up by successive steps

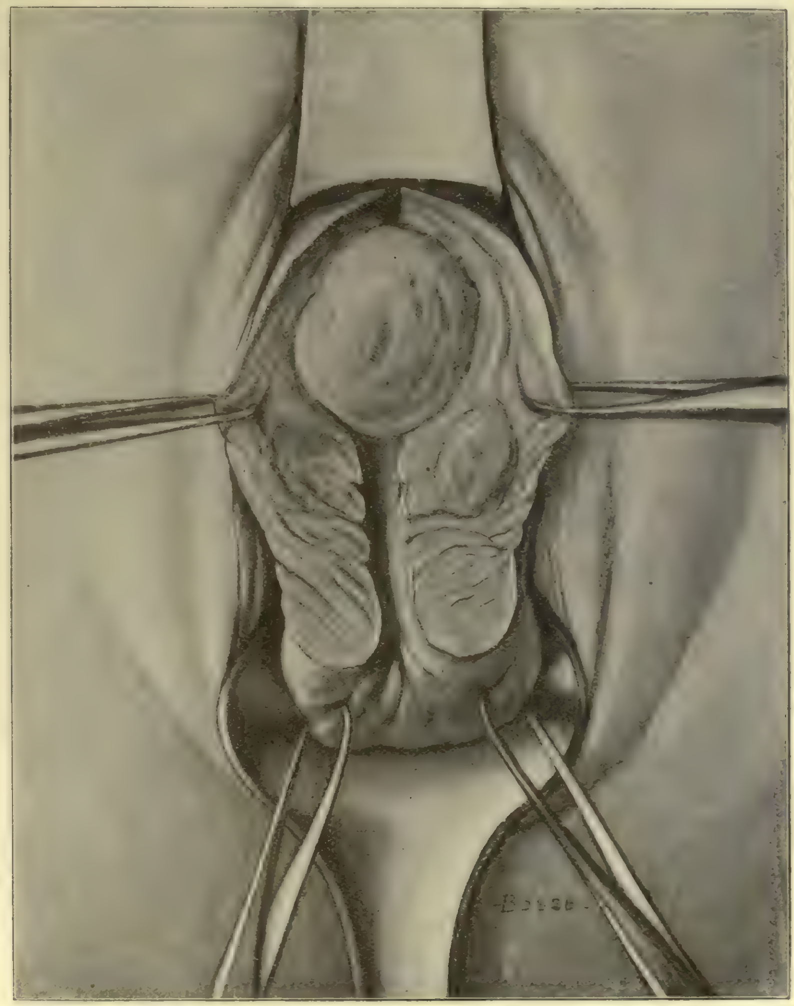

Fig. 245.—Uterus completely opened for submucous fibroid (more advanced stage of Fig. 244).

until if necessary the top of the fundus is reached. The uterus then is practically in the vagina with its cavity freely exposed for its entire length, and any tumours present may be readily removed. An incision is made over the tumour through the endometrium, the tumour exposed and enucleated. The tumour bed is sutured to prevent bleeding and to hasten healing. The uterine wall is sutured, the bladder drawn down into its normal position, and the vaginal incision closed. There is no need of drainage in the uterus or in the vaginal incision.

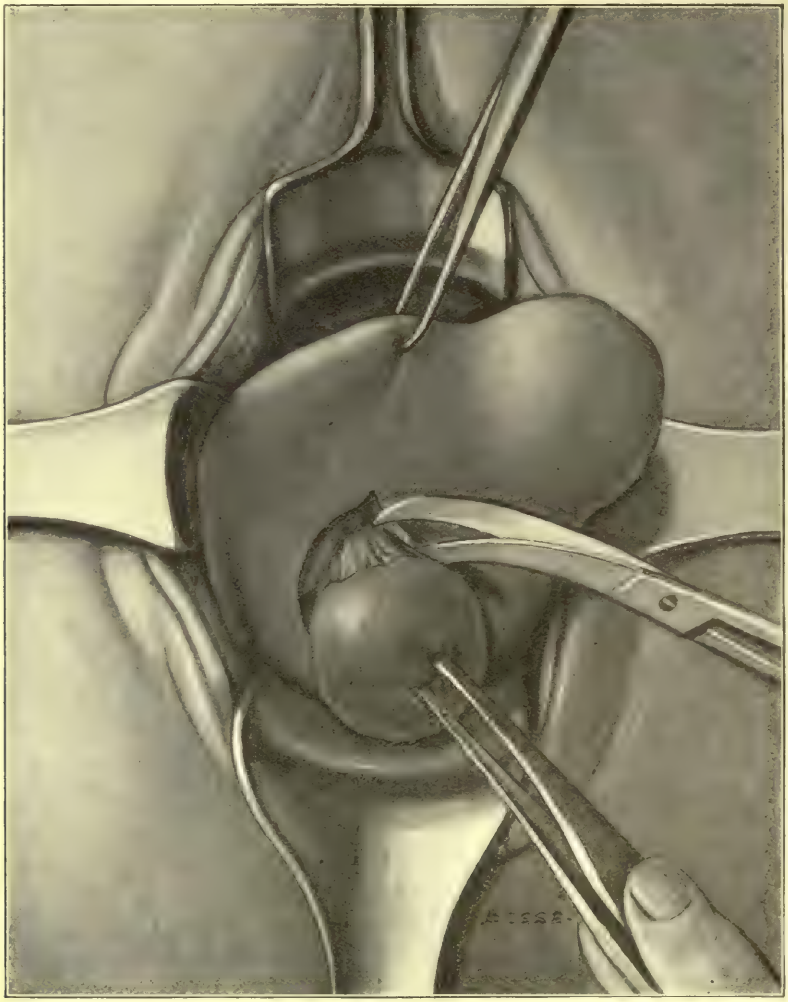

FIG. 246.—The uterus exposed through the anterior vaginal incision and subperitoneal and interstitial fibroids being enucleated.

Technique of Vaginal Myomectomy for Subperitoneal and Interstitial Fibromyomata Uteri.—The cervix is exposed and its anterior lip seized by volsellum forceps and drawn down toward the vulva. The bladder is exposed by the anterior vaginal incision previously described, and is separated from the vaginal wall and from the anterior surface of the uterus. The utero-vesical fold of the peritoneum is opened by a transverse incision extending from one side of the uterus to the other. The fundus is next delivered into the vagina by drawing it forward, as the cervix is pushed back toward the posterior vaginal fornix. If the tumour is too large to be drawn into the vagina and is accessible, its size can be diminished by exsecting a part of it by pieces. This should only be done by the aid of sight, and care should be taken to remove only pieces of the tumour and not any part of the uterus itself.

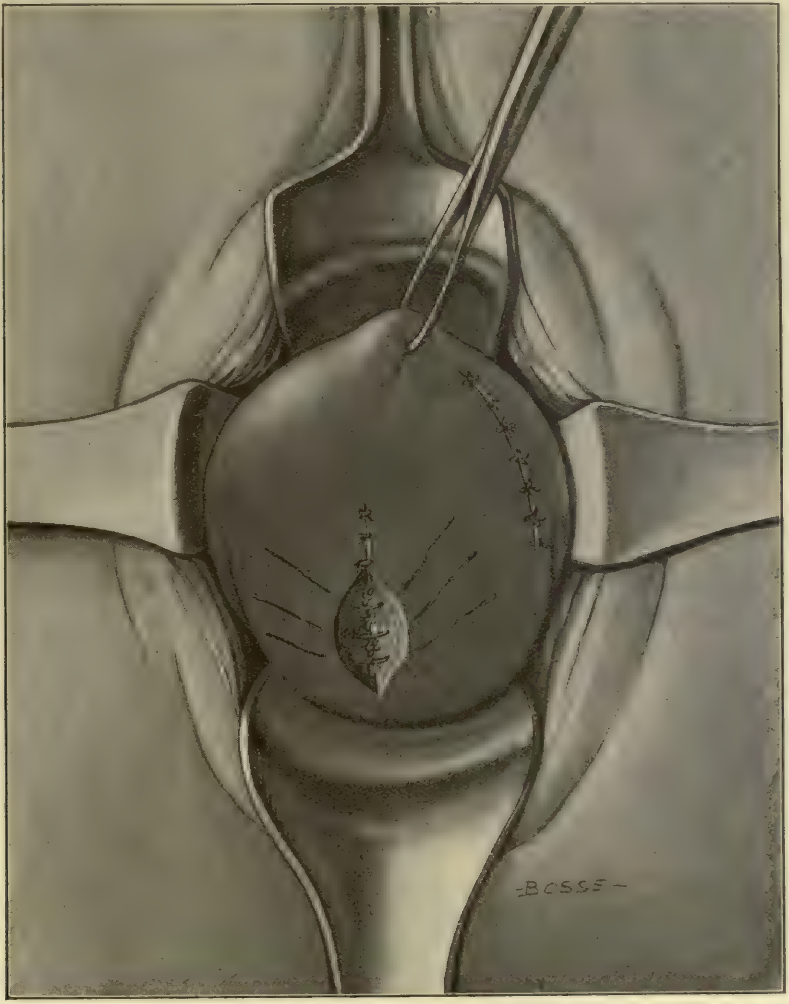

FIG. 247.—Fibroids removed and wounds sutured.

After it has been sufficiently reduced in size, the uterus and tumour should be turned out into the vagina and the remainder of the latter removed.

In doing a myomectomy the incision used to expose it should extend down to the tumour. It is better that the incision should extend *into the tumour* than that the enucleation should be attempted outside the capsule. If the enucleation is made in the proper layer, the fibroid will come out easily and with little bleeding. Haemorrhage should be treated as in other surgical wounds. Bleeding points should be caught and ligated with fine catgut. The cavity should be closed with interrupted sutures of fine catgut, care being taken to leave no pockets (Fig. 247).

As a rule as many fibroids as possible should be removed through the same incision in order to avoid external injury to the uterus and to diminish the chance of peritoneal adhesions. Near the top of the uterus care should be exercised not to injure either of the Fallopian tubes. There is no special risk of injury to ureters unless the tumour is situated between the layers of the broad ligament, and such cases are usually not suitable for vaginal myomectomy.

After the fibromyomata have been removed and the incision in the uterus sutured, the uterus is returned to the abdomen. The opening in the peritoneum is closed, the bladder drawn down to its normal position, and the vaginal incision sutured without drainage.

After-Treatment.—This is very simple. As only catgut has been used, there will be no sutures to remove. If there is any discharge, particularly if it has any odour, the patient should be given a mild antiseptic douche. Otherwise no douches are given. No gauze is put in the vagina. There is no more reason for packing the vagina with gauze after a surgical operation than after a confinement, as in either case it would soon become soaked with the secretions and favour rather than prevent infection. A sterile vulval pad is the only protection necessary.

VAGINAL OPERATIONS FOR PROLAPSE OF THE UTERUS

In any operation for prolapse of the uterus, if there is any laceration or relaxation of the pelvic floor, it should be repaired as part of the complete operation, but as these operations are described elsewhere, they will not be dealt with here. The object of the operations here described is to correct the prolapse of the anterior vaginal wall; in other words, to repair the hernia of the bladder. By the repair of the anterior vaginal wall and the pelvic floor, with or without an amputation of the cervix as may be indicated in the individual case, the prolapse of the uterus itself is corrected.[1]

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[1] See also Article on Prolapse (Vol. II. pp. 653-654).

The operations have developed from those originally described by Mackenrodt and Dührssen for retrodisplacement of the uterus, and are associated in America with the names of Watkins and of Goffe, and in Germany with those of Wertheim and of Schauta. The details of technique of the operations vary with different surgeons but the general principles are the same. In general the plan of the operation is to interpose between the bladder and the anterior vaginal wall, either the fundus uteri or a part of it, or its supporting ligaments. Hence the name 'interposition-operation,' which is frequently given to it. In the end, the bladder has been raised and is fastened higher on the anterior surface of the uterus or rests on its fundus or its posterior surface. Or if the uterus has been first removed by a vaginal hysterectomy, after the ligaments of one side are sutured to the corresponding ligaments of the opposite side, these sutured ligaments may be interposed between the bladder and anterior vaginal wall, the bladder being thus supported on the posterior surfaces of the broad ligaments.

Indications.—The vaginal operation described here should not be performed on women who may still bear children, but should be limited to women who have passed the child-bearing period or who have been made sterile at the operation. The position of the uterus, relative to the bladder and to the anterior vaginal wall, is such that serious difficulty would be encountered either during the pregnancy or at the confinement.

These operations are indicated only in cases in which there is a relaxation or a prolapse of the anterior vaginal wall. In those cases of prolapse of the uterus in which there is a prolapse of the posterior vaginal wall or a rectocele with, possibly, protrusion of the cervix uteri from stretching of the uterosacral ligaments, but without prolapse of the anterior vaginal wall, the operation is not indicated. It would be more nearly correct to describe them as operations for the correction of cystocele than of prolapse of the uterus, but custom has associated them with the operation for the latter.

It is obvious that a large uterus cannot be safely interposed between the bladder and the vagina, and also if the amount of cystocele is small, even a small uterus cannot be interposed between the bladder and the vagina. The proper relation as to size of the interposed uterus and the cystocele must therefore be maintained. If the uterus is too large, it must be diminished by removing from it a vertical or transverse wedge before it can be interposed; or it may be removed entirely and the uterine ligaments used for the bladder-support. If the cystocele is too slight, even a small uterus cannot be interposed between the bladder and the vagina, and the case is not a proper one for the interposition-operation. If the cystocele is large, it will be necessary to remove a part of the anterior vaginal wall, and also in some cases to shorten the natural ligaments or to form new ones for additional support to the uterus itself.

The technique of the operation in a case with a small uterus and a moderate cystocele will first be described, and then such modifications as may be necessary to include other classes of cases.

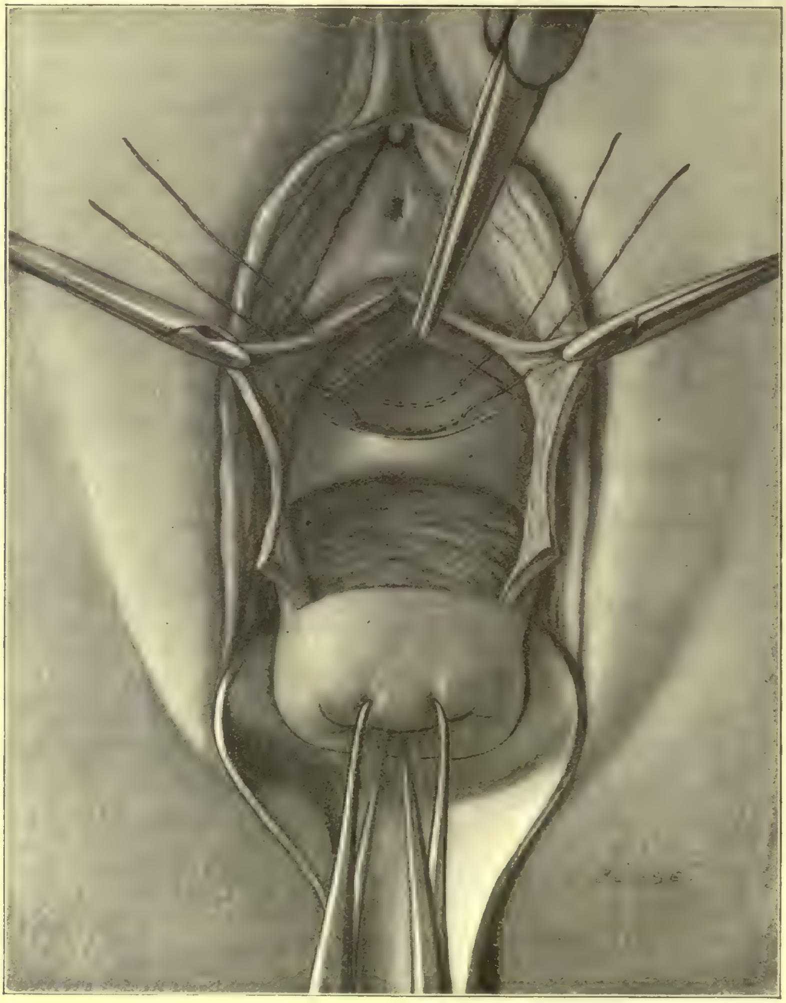

Fig. 248.—Interposition-operation. Anterior vaginal wall sutured to anterior leaf of peritoneum.

Technique.—Unless the cervix is small, free from erosions, and in its normal position, it should be amputated, and it is an unusual case when there is not an indication for the removal of the cervix. In doing the amputation of the cervix, care should be taken to draw the bases of the broad ligaments across the front of the cervix in order to give it additional support and to hold it back nearer the posterior vaginal fornix. The amputation of the cervix can be done either before or after the interposition of the uterus, but if the cervix is ulcerated, as is often the case, it is better to remove it first in order to ensure more perfect asepsis. If, on the other hand, it is clean, it is better to leave the amputation of the cervix until after the uterus itself has been interposed, as it will then be more easy to determine the amount of the cervix that it is best to remove.

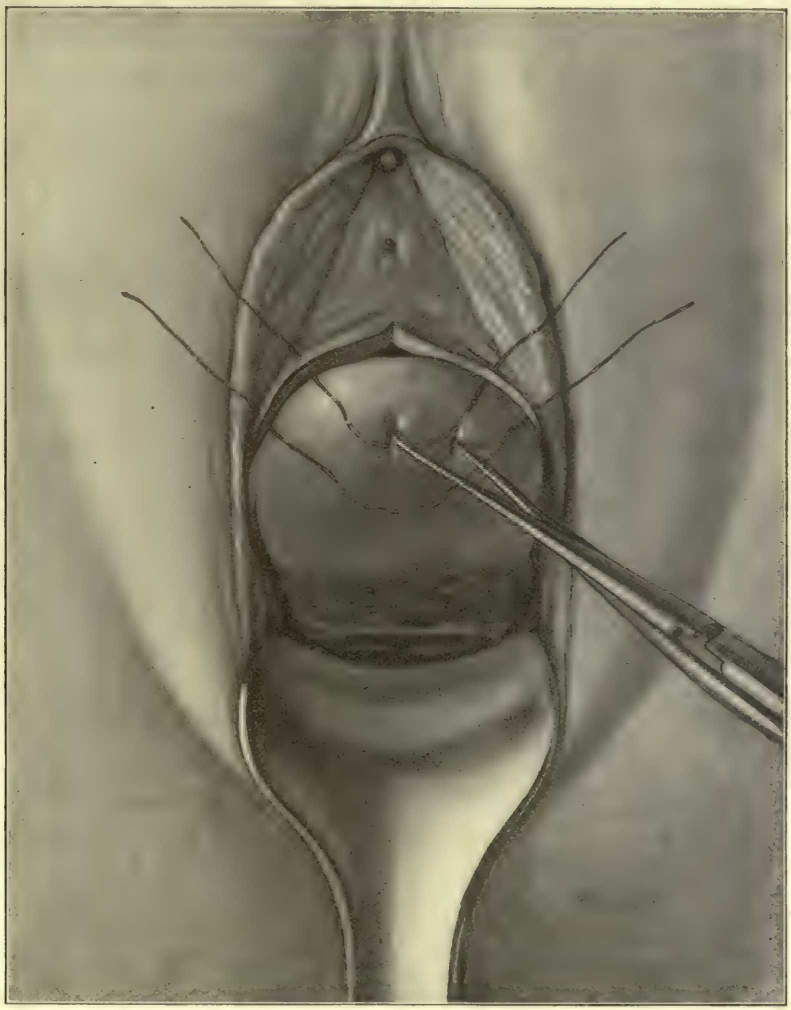

FIG. 249.—Interposition-operation. Anterior vaginal wall sutured to fundus of uterus.

The cervix, after it is exposed with a posterior vaginal speculum, is seized by a volsellum forceps and drawn downward and backward, and the anterior vaginal incision described elsewhere is made. The anterior vaginal flaps are freely separated from the bladder, and the bladder is separated from the uterus, exposing the peritoneal fold of the utero-vesical pouch. This is opened by a transverse incision, and after stitching the anterior peritoneal layer to the vaginal wall (Fig. 248) the fundus of the uterus is exposed but not necessarily turned out into the vagina. Care must be taken that the bladder is well separated from the vaginal flaps below and from the uterus above, as it must be free to rest on the uterus after the latter has been sutured in its new position. Neglect of this precaution is doubtless the cause of some of the urinary disturbances which have been reported following the operation.

If there has been a marked prolapse of the anterior vaginal wall, the redundant vaginal flap should be excised on either side of the median vertical incision. With the bladder held high out of the way, sutures are now passed through the vaginal wall of one side of the median incision, through the fundus of the uterus, and out through the vaginal wall of the other side of the median incision in the reverse direction, thus suturing the uterus to the anterior vaginal wall with the bladder supported on that part of the uterus which is above the first suture passed (Fig. 249). Similar sutures, usually three or four in number, are passed below this first suture, that is nearer to the cervix, including the vaginal wall and the uterus. For suture material it is my custom to use chromic catgut.

The exact location of the first suture, both in the vaginal wall and in the uterus, depends on the amount of prolapse of the vaginal wall and on the size of the uterus. If the uterus is decidedly small, that is a senile uterus, with a moderate prolapse of the anterior vaginal wall, the first suture should pass through the vagina about an inch above the urethra and through the top of the fundus of the uterus. Some operators pass this suture still farther back into the posterior wall of the fundus uteri, but I believe that this does not add to the strength of the support of the bladder and may increase the risk of vesical irritation. If the uterus is somewhat larger, then the suture should pass through the vaginal wall at about the same place but should pass through the anterior wall of the uterus at a point below the top of the fundus, and additional sutures passed below the first one that has been inserted.

The remaining portion of the vaginal incision is then sutured, and the operation is complete.

If the uterus is of such size that it must be diminished before the interposition can be made, the fundus uteri should be delivered into the vagina, and a vertical wedge of proper size (Fig. 250), extending on the anterior uterine wall from the level of the internal os uteri to an adequate point on the posterior uterine wall, is removed, the uterine wound is sutured, and the uterus interposed as already described.

Another way to reduce the size of the uterus before doing the interposition is to remove a transverse wedge from the fundus or to do a supravaginal hysterectomy through the vagina, and then to interpose the stump. From above downward on each side the tube, the utero-ovarian ligaments, the round ligaments, and the upper branches of the uterine arteries are ligated, and the upper part or the whole of the fundus uteri is removed by a transverse incision. The cervical canal is excised as a small cone. The round ligaments and the upper part of the broad

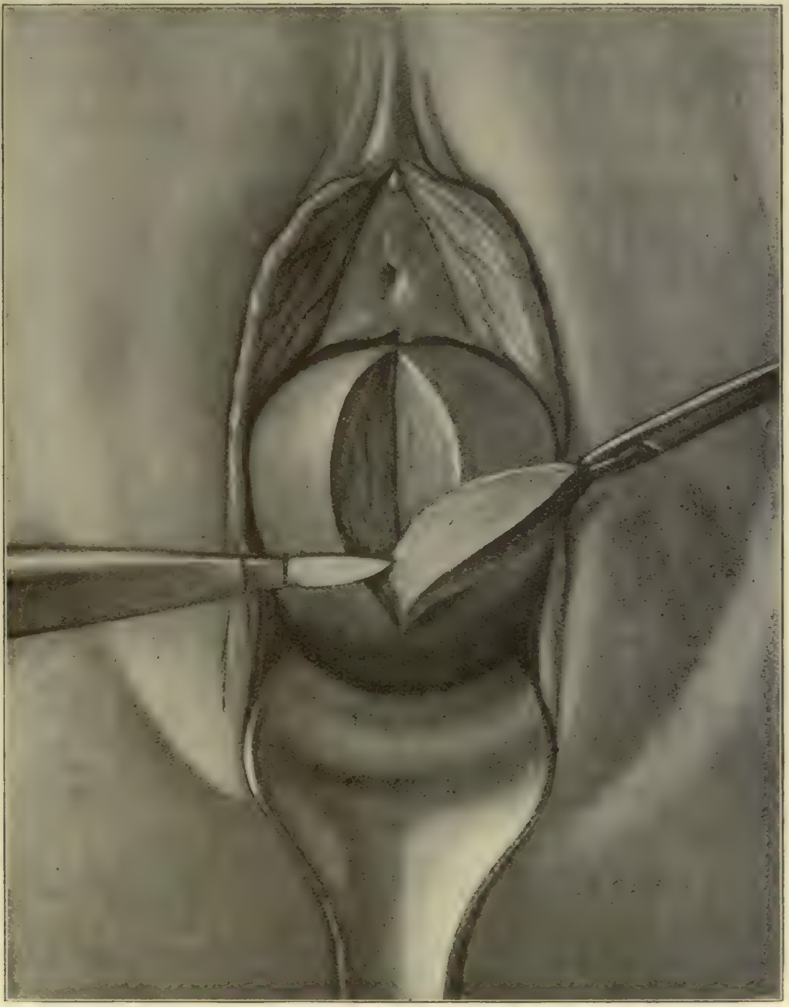

Fig. 250.—Uterus decreased in size previous to interposition-operation by removal of vertical wedge.

ligaments of the two sides are sutured together and also to the cervical stump. This cervical stump, instead of the fundus, is then sutured beneath the bladder to the anterior vaginal wall as has been described. Each suture of chromic catgut is passed first through the vaginal wall on one side of the median incision, then through the cervical stump, and out at a corresponding point to the vaginal wall of the opposite side. From two to four sutures are ordinarily required. The remaining portion of the vaginal incision is sutured, and the operation is complete.

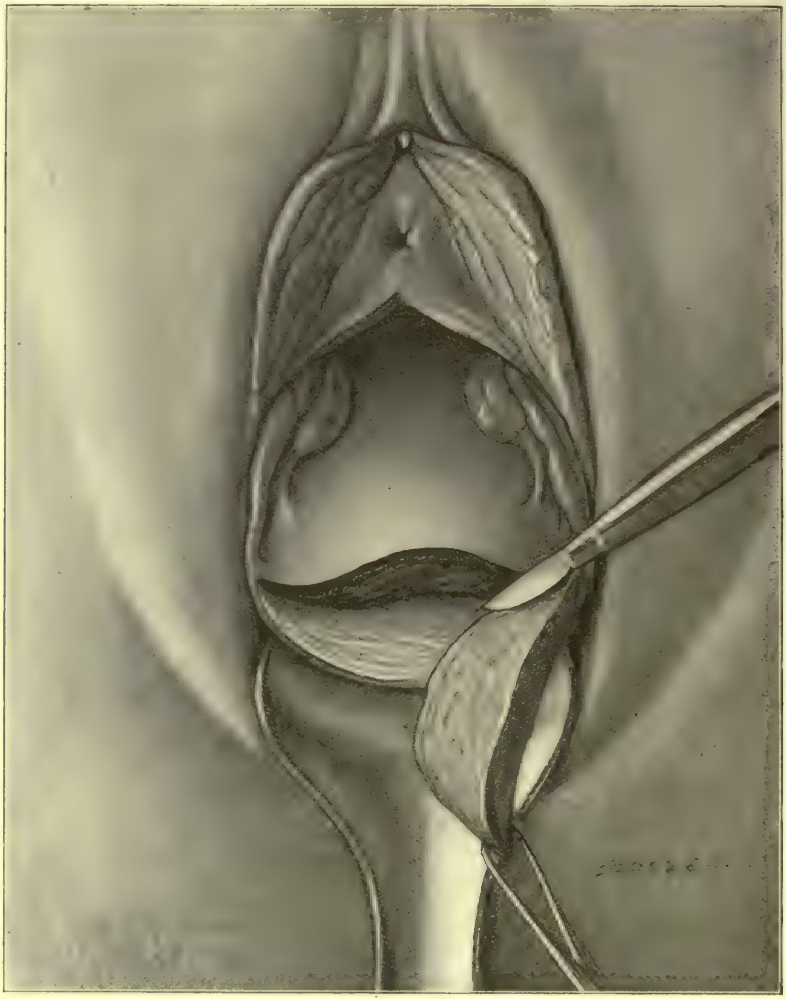

FIG. 251.—Uterus decreased in size previous to interposition-operation by removal of transverse wedge.

Instead of saving any portion of the uterus, it is sometimes preferable to remove the uterus (panhysterectomy) entirely and to use the uterine ligaments to support the bladder and the anterior vaginal wall. The uterus is delivered into the vagina through the anterior vaginal incision, and is removed with clamps which are placed from above downward on each side of the uterus on the round ligaments, on the tubes and the utero-ovarian ligaments, and on the uterine vessels. Any other bleeding points are caught and ligated. The broad ligament of one side is next sutured to that of the opposite side, beginning above with the round ligaments and extending to their bases at the sides of the vagina. The effect of this is to produce a new shelf for the support of the bladder, made up of the broad ligaments, extending above from the round ligaments and below to the sides of the vagina. The round ligaments

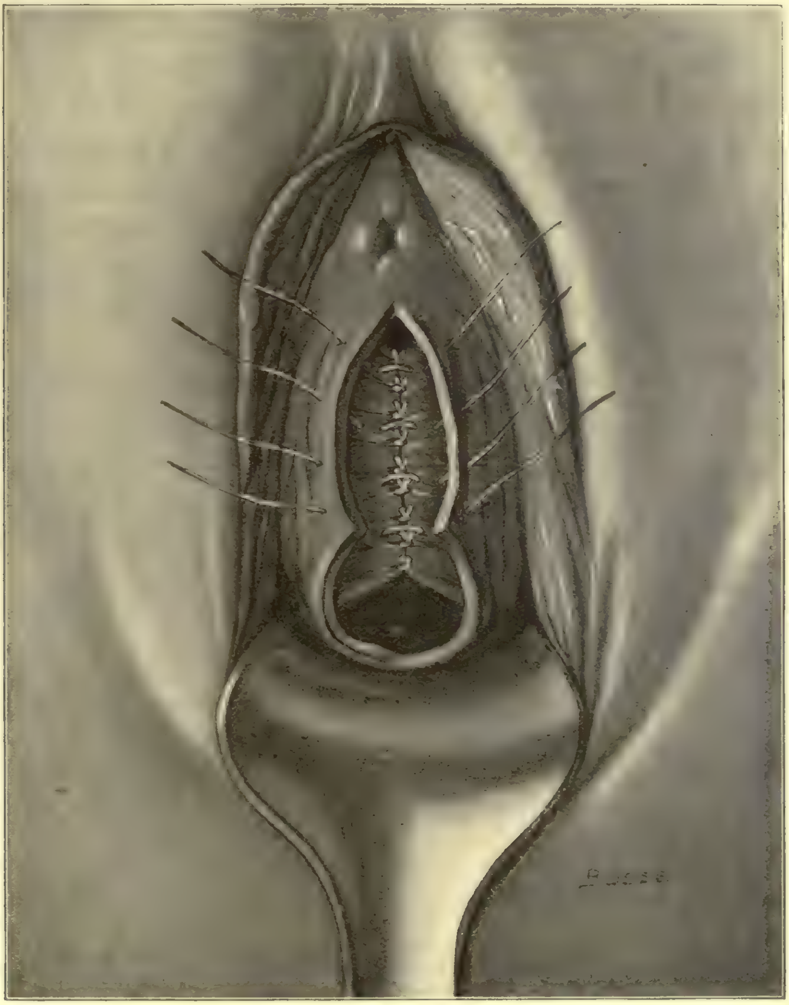

FIG. 252.—Anterior vaginal wall sutured to united broad ligaments.

instead of the fundus of the uterus are sutured to the anterior vaginal wall beneath the urethra as has been described. A suture of chromic catgut passes through the anterior vaginal wall on one side of the median incision, through the sutured round ligaments near their cut ends, and out at a corresponding point of the opposite side of the median vaginal incision (Fig. 252). Additional interrupted sutures are passed uniting the two broad ligaments, along the lines where they have been sutured together, to the anterior vaginal wall at the line of the median incision. Each of these sutures is passed first through the anterior vaginal wall on one side of the median incision, then through the broad ligaments at their junction, and out at a corresponding point on the other side. In this way the broad ligaments are sutured to the anterior vaginal wall, and form a definite shelf for the support of the bladder which is now resting on the posterior surface of the broad ligaments. The remaining portion of the anterior vaginal incision is sutured, and the operation is complete.

Subsequent Treatment.—These cases should remain in bed for fourteen days following the operation, and no douches should be given unless there is discharge which has become offensive. It is not necessary in the writer's opinion to pack the vagina with gauze. Care should be taken during the operation to have as perfect haemostasis as possible, as an accumulation of blood may become infected and interfere with the healing of the wound.

FISTULAE IN THE FEMALE GENITAL TRACT

By Professor J. B. Hellier
(Leeds)

Urinary Fistulae

Causation.—Fistulae of puerperal origin form a group of great importance. Long-continued pressure of the head in impacted labours may cause such lowering of the vitality of the parts that necrosis follows, very much as in a bed-sore, and some part of the septum between the genital and urinary passages sloughs and causes a leak. In a very large proportion of all cases pelvic contraction has been observed, but undue size of the head, as in hydrocephalus, may produce the same result. Impaction of the breech or of any other part may be the cause. There is no constant relation between the duration of the impaction and the occurrence of necrosis, for fistulae have been caused by impaction which has lasted but three or four hours. The general condition of the patient has much to do with the amount of pressure which can be borne with impunity. Neglect to empty the bladder during labour renders it more liable to such injury.

The abuse of obstetric instruments has often been responsible for the production of a fistula either by bruising or by direct laceration. The slipping of the perforator, or of the now obsolete crotchet, or faulty use of the decapitating hook, or the projection of sharp points of the cranial bones after craniotomy have all in turn caused vesical laceration. The use of heavy cephalotribes in highly contracted pelves is very liable to cause dangerous bruising of the soft parts against the pelvic wall, and the unskilled use of any obstetric instrument may entail the same danger. The writer once saw a very extensive slough of the vesico-vaginal septum follow the attempts of a medical student to deliver an impacted head with a pair of Ziegler's forceps. His ignorance of the fact that forceps of this type had to be applied by slipping the fenestrum of the second blade over the handle of the first landed him in hopeless difficulty. Severe laceration of the cervix may occasionally extend to the bladder, but this is not very common because the attachments of these parts are loose especially in pregnancy.

In modern times the practice of scientific midwifery has caused a striking reduction in the number of cases of fistulae of puerperal origin. This is due to the fact that the lesser degrees of pelvic contraction are dealt with by timely application of properly constructed forceps, while in the higher degrees the safety of Caesarean section has caused the more risky embryotomies to be superseded. It is no longer necessary for obstetricians to point out that when fistulae have followed the use of forceps it is because this has been used too late. In places where Western science comes into contact with the methods of primitive midwifery the frequency of urinary fistulae has been emphasised by many observers. Stöckel [1] says that Fritsch saw an unduly large number amongst the poor Polish Jewesses in Warsaw, Cracow, Vienna, and Breslau, and he attributed this to early marriage, small pelves, rigidity of the soft parts, and to the practice of unskilled midwives and charlatans. Dr. R. S. Dobbin informs the writer that urinary fistulae are very common in Egypt, and that in the Kasr-el-Ainy hospital at Cairo amongst 2657 gynaecological operations, 117 were cases of vesico-vaginal and 7 of vesico-cervical fistulae. These 124 cases were all due to prolonged labours. They thus amounted to 4·6 per cent of all gynaecological operations performed. Many girls in Egypt marry at 10 years of age, and are mothers before they are 13 ; labours lasting four days are not uncommon, and some suffer in child-birth for a week or ten days. In India similar observations have been made by English and American lady practitioners who have access to the Zenanas. They see many severe cases of fistulae and other birth injuries in native women who have been many days in labour, attended only by women who are ignorant and brutal to the last degree in regard to all that concerns a midwife's art. In reckless attempts to assist labour they will often cut a patient's genitals with sharp instruments in a savage and senseless manner.[2]

Unfortunately it cannot be said that modern obstetrical operations enjoy a complete immunity from fistula production, for vaginal Caesarean section, symphysiotomy, etc., have been followed by damage to the bladder and urethra. Attempts to procure criminal abortion sometimes wound the bladder. After a fistula has been cured relapse may occur at a subsequent delivery.

Fistulae of Non-Puerperal Origin.—In the later stages of malignant disease of the uterus, vagina or bladder perforation may occur, and the urine may be found leaking away. Occasionally a vesical calculus has ulcerated through either in connection with labour or otherwise.

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[1] *Veit's Handbuch der Gynäkol.* ii. 446.

[2] See a paper on "The Methods of Primitive Midwifery," by J. B. Hellier, *Lancet*, Feb. 8, 1901.

Amongst other rare causes may be mentioned specific ulceration, and the pointing of an abscess due to suppurating phlegmon or suppurating haematoma. The writer has recently seen a case of vesico-vaginal fistula which occurred spontaneously in a child of five who had a tuberculous knee. Occasionally perforating wounds have been caused by a fall on a spike, thorn, or other sharp point. Emmet mentions a case due to a pistol shot, and Torrance, one caused by goring by a bull. Some cases have been due to brutal sexual relations. It is of special importance to note that foreign bodies long retained in the vagina may ulcerate through. Vaginal pessaries which cause dangerous pressure on the vaginal walls are now we hope becoming obsolete, although such are still figured in most instrument catalogues. There is perhaps hardly any kind of pessary that may not cause ulceration by long retention, but those of the expanding or "butterfly" type, such as the Zwanck-Schilling pessary, are the most dangerous. If the screw becomes corroded, and the patient cannot withdraw the instrument, she may wear it for months and years till incontinence of urine leads her to seek advice. The writer saw a woman who came to the Leeds Infirmary after wearing an impacted Zwanck-Schilling pessary for at least five years. He found one blade in the bladder and one in the vagina. He saw a similar case caused by a Simpson's "shelf pessary."

Procidentia with cystocele is very often associated with some ulceration of the vaginal wall, and this may occasionally perforate the bladder, or the prolapsed wall may be the seat of accidental laceration.

Post-Operative Fistulae.—These form a group which has acquired some prominence of late years especially in connection with panhysterectomy for *carcinoma cervicis uteri*, whether by the vaginal or abdominal route. Such fistulae may be vesical or ureteral. In vaginal section it is not very difficult to separate the bladder from the cervix, push aside the ureters and open the abdomen, but if the tissues be infiltrated by inflammatory products or by cancer cells they may easily tear, or the ureters may be caught in a hysterectomy clamp. In almost any vaginal section the ureters may be wounded, but in the removal of pelvic tumours, inflammatory or otherwise, by the vaginal route the ureters are specially liable to injury.

In abdominal section the removal of intraligamentous or retroperitoneal tumours always requires great care, especially when the ureters are displaced. In radical operations for carcinoma the ureters have to be dissected out of their sheaths, and there is often thickening in the peri-ureteral connective tissue which makes such dissection difficult. If the ureters be not wounded at the time of operation local necroses may follow operation owing to interference with vascular supply, and after a day or two urine may be found leaking through the vagina.

In palliative operations for carcinoma cervicis by scraping and cauterizing, urinary fistula may be caused. We are now told that even after the use of radium, causing diminution in malignant growth around the cervix and bladder, urinary fistulae may follow.

Congenital urinary fistulae are seen in hypospadias and in some other defects.

Fistulae may be established between the urinary passages and some part other than those already mentioned. Intraperitoneal or parametric abscesses may perforate the bladder. Thus also a suppurating ovarian cyst, suppurating ectopic gestation-sac, pyosalpinx, or appendicular abscess may open into the urinary tract. If such an abscess communicates with the bowel, flatus and faeces may enter the bladder. Entero-vesical fistula may follow abdominal section when many adhesions have been separated, as in enucleating a broad-ligament cyst.

Noble saw an ischio-rectal abscess perforating the bladder, and he demonstrated the communication by injecting hydrogen gas into the fistula and by lighting the gas at the end of a catheter in the bladder.[1]

Varieties of Urinary Fistulae.—These are classified according to their position. Thus we may find *urethro-vaginal, vesico-vaginal, vesico-cervical, uretero-vaginal,* and *uretero-cervical* fistulae, and there may be combinations of the above. *Urethro-vaginal* fistulae may involve the urethra and not the bladder and then the urine will leak only during micturition. *Vesico-vaginal* fistulae are the most common. If they extend forwards and also involve the urethra they are called *vesico-urethro-vaginal,* and if the sphincter vesicae be partly destroyed the difficulty of repair is much increased.

Sometimes a vesico-vaginal fistula is complicated by the fact that one or both ureters have their openings in the margin of the fistula. It is then called *vesico-uretero-vaginal.*

Some of the worst fistulae are caused when the cervix uteri and bladder are crushed against the pubic symphysis. The slough which follows may destroy the base of the bladder and more or less of the cervix. In this way there may be formed a *vesico-cervical* fistula. In such a case the urine may flow from the os externum if the supravaginal portion of the cervix has been involved. These fistulae have been called *vesico-uterine,* but they are almost uniformly cervical. Sometimes the ureter communicates with the cervix. It seems very likely that in such cases there has been at first a larger defect which has partly closed leaving the ureteral leak.

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[1] *Medical and Surgical Reporter,* Jan. 19, 1889.

If the anterior labium has sloughed there may be a large gap involving bladder and vagina and cervix and possibly the ureters also, and such may be named according to the parts involved.

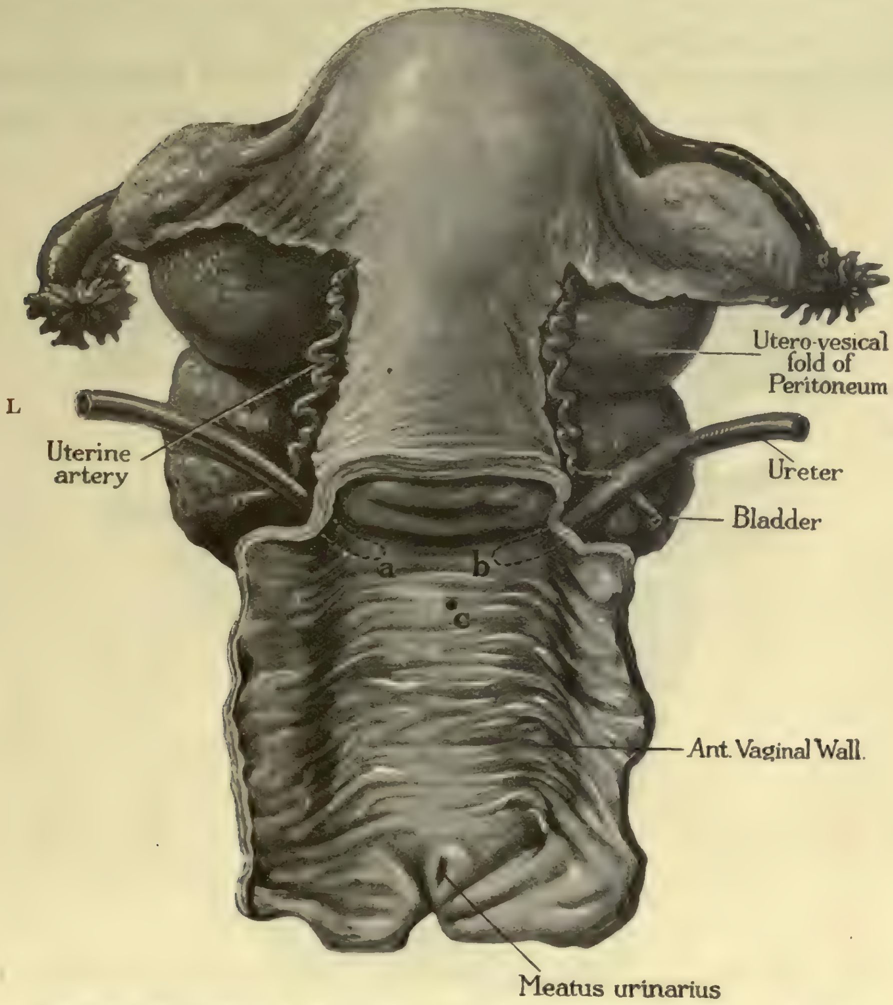

Fig. 253.—Dissection to show relation of trigone of bladder to cervix and vagina. *a* and *b* correspond to left and right ureteral orifices respectively, and *c* to internal urethral orifice.

Pure *uretero-vaginal* fistulae are sometimes seen. If they are of puerperal origin they are usually caused by injury to that part of the ureter which lies in the bladder wall. If they are post-operative the seat of injury may be higher, *e.g.* near the place where the uterine artery crosses the ureter, and a sinus from this spot will run down to the vaginal wound, taking often a devious course, and possibly opening into the vagina on the side opposite to that on which the damaged ureter is situated. This is an important point in diagnosis.

It will be useful to refer to some points in regard to the anatomy of the base of the bladder and the ureters.

Observations on the Variability of the Relations of Vagina, Bladder, and Ureters. —The last 10 to 15 mm. of the ureter lie first in the muscular coat of the bladder and then between the muscular and mucous coats. The vesical orifices of the ureters are on the average about 30 mm. apart, and the internal urethral orifice is about 15 mm. in front of the line joining the ureteral orifices, and 30 mm. in front of the cervix. But these relations vary in different subjects and in the same subject according to whether the uterus is pregnant or not and according to the fulness or emptiness of the bladder. Dr. J. C. Brash, of the Anatomical Department of the University of Leeds, has kindly assisted the writer in making some observations on this question.

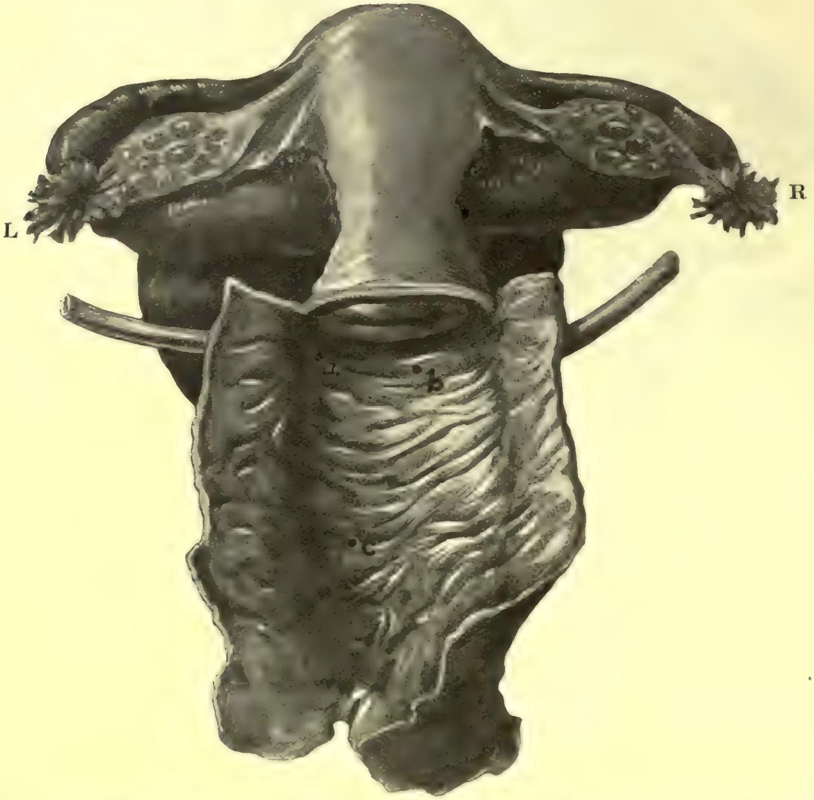

FIG. 254.—A second dissection, showing relations varying greatly from those seen in Figure 253.

From several post-mortem subjects whose pelvic organs were normal the uterus, vagina, and bladder were removed *en masse*, fixed with formalin, and exposed to observation by opening the bladder anteriorly and the vagina posteriorly. Three pins were then passed in each preparation from the bladder to the vagina. One was passed through the centre of each ureteral orifice and one through the internal urethral orifice. The point at which each pin emerged on the vaginal side was then noted. In the accompanying drawings *a* and *b* mark points in the vagina opposite the left and right ureteral orifices respectively, and *c* marks a point opposite the internal urethral orifice. Figure 253 shows the relation of the parts in a woman of 59, a multipara. The position of the ureteral orifices is well seen, but the point *c* shows that the internal urethral orifice is only 17 mm. in front of the cervix instead of 30 mm. This figure shows very clearly the position of the utero-vesical peritoneal fold which had been distended with cotton-wool. Figure 254 is from a virgin of 14. Here the point *c* is 37 mm. from the cervix

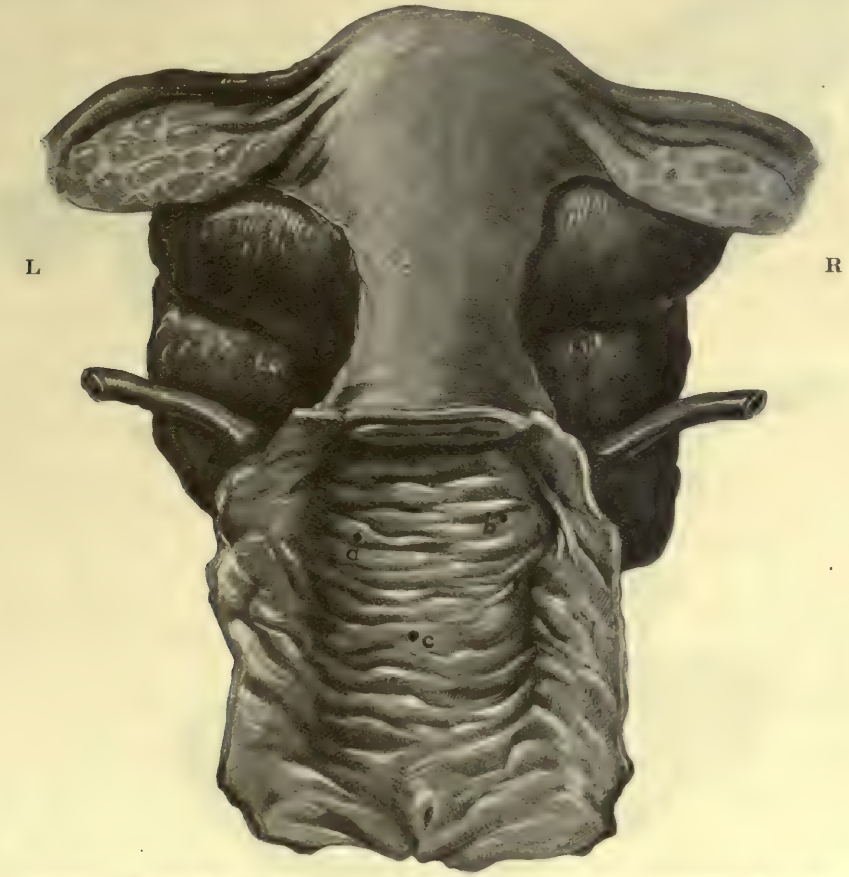

FIG. 255.—A third dissection, showing relations varying from Figures 253 and 254.

and the trigone lies more to the left than the right. Figure 255, taken from a parous woman of 39, shows relations intermediate between the other two, *b* lying a little higher than *a*, and *c* lying 31 mm. from the cervix. Figure 256, from a multipara, shows relations that are markedly asymmetrical. The point *a* lies nearly in the middle line while *b* falls outside the vagina just beyond the right lateral wall.

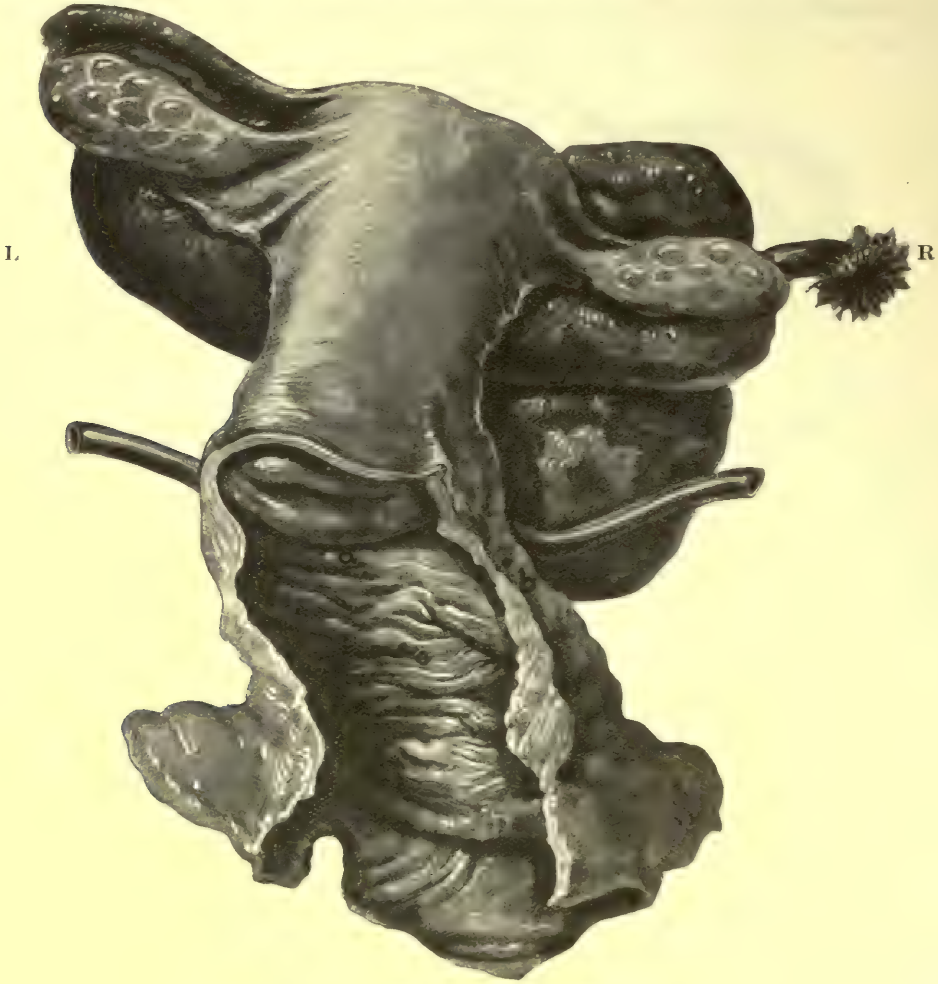

Fig. 256.—A fourth dissection, showing marked asymmetry. Point *b* falls outside the right vaginal wall.

These observations show that the position of the trigone is variable and may be asymmetrical. In fact those who have studied frozen sections of the pelvis know that perfect symmetry is rarely found. Great fallacy might result from assuming from the position of a vesico-vaginal fistula that it must have involved or must have avoided the ureters. If after a previous delivery there has been any pelvic inflammation, the parts may be found fixed or distorted by adhesions, and probably under such conditions they are more liable to injury during prolonged labour.

Characters.—Vesico-vaginal fistulae may be of almost any size. They may admit one, two, or three fingers, or may involve the destruction of almost the whole vesico-vaginal septum. They may on the other hand barely admit a probe, and may be so small that they are difficult to locate. They may be round, oval, linear, or irregular. They may be central, or lateral, and possibly multiple. Simon, for instance, operated on a case where a vesico-vaginal fistula was complicated by a uretero-vaginal fistula opening separately behind it.[1] The edges of a fistula may be thin or thick, they may be soft or hard and cicatricial, they may be vascular or anaemic. Sometimes they are firmly adherent to the bone, and this is a very unwelcome complication. There may be cicatricial bands in the vagina and it may be so much stenosed that it is difficult to expose the fistula. The fistula may be concealed behind cicatricial folds and the vagina may show pouches in which urine collects.

The vesical wall may have sloughed more than the vaginal wall and so the fistula may be conical with its base to the bladder.

Symptoms and Complications.—The most characteristic and distressing symptom is persistent incontinence of urine. If the bladder has been actually lacerated in labour this will be present from the first. The patient will pass no urine *per urethram*, there will be no distension of the bladder, and no desire to micturate. This will distinguish the case from one of overflow of the distended bladder. If the fistula follow sloughing there may be at first haematuria and symptoms of cystitis, with local pain and febrile reaction and sepsis. In three or four days or more the slough will begin to separate and the urine to leak away. Sometimes the actual separation of the slough is determined by a strain or cough, and the patient may feel that something has given way suddenly. Occasionally the separation of the slough has been delayed for many days. Schuppert records a case in which the separation of the slough was delayed for twenty-nine days after labour.

The effect on the patient of the persistent incontinence is to reduce her to a most miserable condition of mind and body. Even if she can afford constant change of clothing and bedding she becomes offensive to herself and others, while if she be poor and uncleanly her condition rapidly becomes most pitiable, and her incapacity to follow any ordinary employment, and her social disabilities, reduce her to destitution. The urine becomes ammoniacal, and cystitis and leucorrhoea are present. The parts become encrusted with urates and phosphates, and there is an offensive urinous odour. At first the vagina is fairly tolerant of the urinous discharge, but in course of time vulvitis and vaginitis are set up, with erythema of the external genitals, perineum, thighs, and buttocks, especially in weak unhealthy subjects. The skin becomes sore, excoriated, ulcerated, and even a pustular eruption may be set up. The pubic and vulval hairs become matted and encrusted with urinary salts, and severe pruritus may supervene. In a large fistula the anterior wall of the bladder may prolapse and appear at the vulva so that the bladder is almost completely inverted. The inverted bladder forms an inflamed, tender swelling which bleeds readily and is exquisitely tender so that locomotion is greatly impeded. Menstruation is often absent in cases of vesico-vaginal fistula, and sterility is a common although not invariable complication. Attempts at coitus have been known to involve penetration through the fistula into the bladder with proportionate infliction of pain on the woman.

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[1] *Deutsche Klinik*, 1856.

The bladder shrinks and loses its elasticity. The urethra often becomes stenosed, and being involved in cicatrices may become adherent to the bone, occluded, or even obliterated. The uterus is seldom found to be normal for there is often some damage to the cervix, and some ascending infection with loss of uterine mobility owing to perimetritis or parametritis.

It may be asked whether there is much tendency for infection to ascend to the kidneys. Stöckel points out that so long as the ureteral orifices are intact and preserve their protective function the kidneys remain healthy in most cases although there are exceptions, but when the ureters are opened by fistulae ascending infection is very likely to develop, and death may result.

Diagnosis.—Incontinence of urine is an almost unmistakable symptom, but the incontinence due to a fistula must not be confounded with that due to incompetence of the sphincter vesicae. In cystocele there is often some partial inability to retain urine, but the patient keeps dry at night and can retain most of her urine in the bladder. In small fistulae the patient may be able to retain a certain amount of urine in some positions of the body, such as the recumbent or the sitting posture. In unilateral ureteral fistulae half the urine leaks away while the other half enters the bladder and is voided naturally.

Physical diagnosis rarely presents any difficulty in the case of vesico-vaginal fistula. On examination the vagina contains urine, and a sound passed *per urethram* will enter the vagina. It is usually easy to find the fistula with the finger and expose it with the speculum. Very small fistulae are sometimes not easily found, but if the bladder be injected with coloured sterile fluid this can be seen streaming into the vagina. Fistulae of capillary size lying in the fundus vaginae and concealed by cicatricial folds present the most difficulty.

The fistula must be carefully examined with regard to conditions affecting its operability. One must test the mobility of its edges and note the presence of granular patches and of cicatricial bands or adhesions. The mobility of the uterus must also be estimated. The urine must be analysed, and it is wise to explore the bladder thoroughly by cystoscopy to make sure that no calculus is present. The orifices of the ureters should be located. A vesico-vaginal fistula seen through the cystoscope shows a black surface due to the non-reflection of light. It is not always easy to find the ureteral orifices, and raising the base of the bladder by a spatula in the vagina may help the observer.

The general health of the patient and the condition of the external parts must be observed in view of the necessity of measures for preliminary treatment.

Spontaneous Healing of Fistulae.—The normal bladder wall is vascular and tends to heal well. A clean cut or laceration may close spontaneously. When the bladder wall is incised in vaginal lithotomy and sutured it usually heals well, and when cystitis is treated by vaginal cystotomy it is not always easy to keep the wound open. Tears of the bladder in labour may close, and small fistulae due to sloughing after labour may heal in three or four weeks. Even large fistulae diminish in size considerably, but after a month there is little likelihood of spontaneous cure. The hard cicatricial anaemic edges of an old fistula are much less favourable for operation.

Operative Treatment of Urinary Fistulae

Historical Note.—The systematic and successful operative treatment of this condition dates from the middle of the nineteenth century. Up to that time it was the despair of surgeons, and cases were dismissed from hospital as incurable. Sir J. Y. Simpson spoke of it as " perhaps the most distressing and deplorable of all the infirmities to which woman is liable . . . long looked upon as incurable and reckoned among the opprobria of surgery, a condition looked upon as beyond all relief and all hope."[1]

It is remarkable that a lesion so palpable as a leak in the bladder with a symptom so obtrusive as permanent incontinence of urine should be almost unnoticed in ancient medical writers. No description has been found in Greek, Roman, or Arabian writers. References to it in literature begin about the end of the sixteenth century. Ambroise Paré in 1570 proposed to close fistulae with a *retinaculum*. From this time onwards various methods of treatment were discussed. Cauterization was used, and divers appliances to be employed in cure were designed, ingenious, complicated, and uniformly ineffective. Among such were conical plugs and Lallemand's *sonde araigne*, which was a sort of catheter with hooklets. The idea of paring and suturing the edges suggested itself early, but surgeons did not see how to accomplish it successfully.

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[1] *Clinical Lectures on the Diseases of Women*, 1872.

An interesting account of the earlier attempts to deal with the condition will be found in a monograph by Schuppert of New Orleans (1866). In 1660, Roonhuysen of Amsterdam proposed to expose the fistula with a speculum, paring the edges, and using a needle made from the quills of a swan, but it does not appear that he actually performed the operation. Occasional cures were recorded by various operators who pared and sutured by various methods. We would specially mention a paper by Gosset in the *Lancet* for 1834, describing his successful treatment of a vesico-vaginal fistula of puerperal origin and of 11½ years' standing which was complicated with a large calculus. He operated with the patient in the knee-elbow position, paring the edges and passing silver-gilt sutures with a curved needle, and he retained a catheter in the bladder in the after-treatment. He seems to have thus recognized the conditions of success, and cure followed. Nevertheless we find Liston saying, in his *Practical Surgery*, in 1846 that little benefit had resulted from attempts to pare and suture the edges.

In 1852 Jobert de Lamballe of Paris published a treatise on fistulae which records an interesting series of cases of vesico-vaginal fistula, many of severe type, which he had cured by a method of paring the edges, combined with incisions freely made in the vaginal wall to liberate the edges of the fistulae and allow them to come together easily. He called his operation *la méthode autoplastique par glissement*, and he declares that those who witnessed his operations were astonished both at the freedom with which he made his incisions and at the benefit derived from them. He must be regarded as one of the pioneers of successful treatment.

American surgeons of the same period claim a foremost place in the development of the operative treatment of vesico-vaginal fistula. Mettauer of Virginia recorded successes by paring the edges and using silver-wire sutures, and also Hayward of Boston, but it is to Marion Sims of Alabama that we owe the chief debt. In 1852 he published his method,[1] and he claimed credit for establishing three conditions of success, first, the thorough exposure of the fistula by the use of his "duck-bill" speculum in the semi-prone position, secondly, the use of silver wire for suturing, and thirdly, the use of a catheter retained in the bladder in the after-treatment. He also described the proper way of bevelling the edges. The use of silver wire was a great improvement on unsterilized silk, being a reasonable approximation to an aseptic suture, and Sims in his enthusiasm said that the introduction of silver wire for sutures was the greatest surgical improvement of the nineteenth century. He secured his sutures with "clamps" which consisted of two parallel bars. By 1864 Sims had cured 230 cases out of 312. Bozeman of Alabama followed in 1856 with further cases, and he designed a method of securing the sutures by drawing them through a leaden "button." About the same time G. Simon of Darmstadt, working independently of Sims, introduced a similar method into Germany. He used a double row of sutures, one to close the edges and another row to take tension from the first.

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[1] "On the Treatment of Vesico-Vaginal Fistula," *American Journ. of Med. Sciences*, vol. xxiii. p. 59.

From this time onwards successful operations became frequent. There was abundant material to work upon, for the arrears of a generation were awaiting cure, and the brilliant success achieved by many surgeons at this period in pre-Listerian days shows how much operative experience counts for in dealing with this condition. In 1868 Emmet of New York, a pupil of Sims, published a treatise[1] on the subject based upon an experience of over 270 cases of all degrees of severity, and his account of the various successful expedients by which he dealt with each case according to its special features will well repay study.

During the last decades a great addition to our resources has been gained from the so-called method of "flap-splitting," which we owe to Sänger and Walcher and others. The modern gynaecologist has also acquired experience in separating the bladder, and opening up the vaginal *cul-de-sacs* and interposing the uterus, which has led to many ingenious plans for dealing with the more difficult cases.

It will be best first to describe the old so-called "classical" operation by paring the undivided edges of the fistula and suturing them; then to explain in detail the modern operation of "flap-splitting or *dédoublement*," and then to refer to some of the methods that have been devised for dealing with more complicated cases to which the former operations are not applicable without modification.

Methods other than operative for dealing with urinary fistulae are now regarded as useless or worse. The action of the cautery, actual or potential, usually not only fails but makes subsequent plastic operation less successful, and attempts to cure by plugging the aperture and retaining a catheter in the bladder were abandoned as soon as the classical operation was known. Simpson said he had tried all such methods and found them useless.

Preliminary Treatment.—It is necessary to prepare the patient for operation by building up the general health and by getting the parts into the best possible condition. It is very unwise to operate in the presence of unseparated sloughs or of granular surfaces covered with purulent discharge, or when there is cystitis with septic urine and the external parts are inflamed. Weak cachectic patients should be admitted into hospital for rest in bed, tonics, good food, and massage.

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[1] T. A. Emmet, *Vesico-Vaginal Fistula*, New York, 1868.

Local treatment is of special importance. The vagina and bladder are to be irrigated systematically with suitable mild antiseptic solutions such as permanganate of potassium, boric acid, or izal, etc. For cystitis one may prescribe urotropin, and acid phosphate of soda, with buchu and demulcents. Incrustations of urinary salts may be carefully wiped away with gauze, granular surfaces may be treated with silver salts, and ichthyol and glycerine tampons used. The external parts are treated with boric acid ointment or vaseline, and lead lotion is very useful for erythema. Great benefit is to be derived by making the patient sit in hot water two or three times daily for a half-hour to one hour or more. Constipation must be suitably treated.

The linen must be renewed constantly, and it is important to prevent the patient from simply drying urinous diapers and reapplying them without previous boiling. Preparatory treatment may need to be continued for weeks or even months, but it is time well bestowed. Lying in the open air in a shelter is likely to be useful.

Galabin designed a special portable urinal for use in vesico-vaginal fistula, the vagina being plugged with an air ball with central drainage into a rubber reservoir, and he claimed that this would keep the patient dry day and night. Enquiry from experienced nurses shows that this does not quite fulfil such promise, but that it is the least unsuccessful of such appliances.

In regard to preliminary treatment, it should be said that some operators have practised methods designed to dilate a contracted vagina and render the fistula accessible for operation. Thus Bozeman[1] advocated the division of cicatricial bands and the dilatation of the vagina by graduated rubber dilators which varied in diameter from 30 to 60 millimetres. This treatment might occupy days or weeks but he claimed that the vagina could be fully dilated, and the thickened edges of the fistula rendered soft and yielding. Emmet practised similar preparatory measures, dividing the cicatrices and making the patient wear Sims's glass dilators in the vagina. Modern opinion is against such measures for they may involve suppuration and local irritation which imperils the healing of the fistula. It is now thought better to incise and stretch cicatricial bands and adhesions at the time of operation.

Time for Operation.—It is not well to operate immediately the puerperal period is over, but to wait till all granulation has ceased. Two or three months usually suffice, but Döderlein and Krönig advocate waiting three-quarters of a year. Simon operated on a child of 8 years of age for a fistula due to a calculus. Polossón cured a fistula in a patient of 80, and Hegar operated successfully on a hemiplegic. Operation has also been successful during pregnancy. Should a recto-vaginal and a vesico-vaginal fistula coexist it is best in most cases to cure the rectal fistula first.

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[1] *New York Journal of Medical Sciences*, Oct. 1, 1887.

Anaesthesia.—Operation without anaesthetic is feasible in short easy cases, and is said not to be very painful (Schuppert). A general anaesthetic is usually preferred but spinal anaesthesia answers very well. R. S. Dobbin of Cairo, who has had much experience of spinal anaesthesia by stovaine in such operations, speaks warmly of the advantage derived from the very complete relaxation produced and the consequent accessibility of the fistula for operation. Local anaesthesia by injection into the tissues renders them sodden and does not promote satisfactory healing (Stöckel).

Antiseptic Precautions.—It is obviously difficult to render sterile the field of operation in such a complicated part as the genito-urinary tract in a fistula case. Strong antiseptics are not advisable. Constant irrigation with some mild aseptic solution such as lysol is useful. For some years the writer has used yeast suppositories for the preparation of cases for vaginal operations. Pessaries of yeast, smeared with syrup, are introduced each night into the vagina. The passage fills with a frothy discharge, and the growth of the yeast fungus kills off streptococci, gonococci, and other organisms. Each day the vagina is washed out with plain sterile water and a suppository again inserted. This plan is safe and efficacious.

Position for Operation.—The knee-elbow position was used by the older operators. It gives a good exposure and is useful when there is vesical prolapse through the fistula. The genupectoral position was used by Bozeman and Neugebauer and others on tables specially designed. The semi-prone position, also called Sims's position, was employed by Marion Sims and his followers, the posterior-vaginal wall being retracted with the duck-bill speculum. Most excellent work has been done with this position. The perineal lithotomy position is, we think, the best for most cases. A good modern operating-table has appliances for supporting the legs and also for raising the buttocks as high as desired. An extreme degree of the position is usually most convenient to the operator, but there is no one position best for all operations; that one is best which gives most complete exposure in the individual case.

The patient's legs and genitals are covered with a sheet which has an oval aperture to expose the vulva. One edge of this aperture is fastened to the perineum with a skin clip so as to cover the anus, and the upper edge is secured to the mons veneris. An assistant stands on each side of the operator to hold what retractors are needed. Sometimes Auvard's weighted retractor is useful, but very often the parts are best exposed by direct retraction by suitable retractors held by assistants. Nothing facilitates operation more than having the cervix drawn down to the fullest possible extent by a volsella or by long sutures passed through the cervix, as in Figure 258. If division of cicatricial bands will facilitate the drawing down of the uterus this should be done freely. Some have even opened the posterior *cul-de-sac* and have divided the utero-sacral bands for this purpose. A well-curved bladder sound ending in a small bulb may be used to pass in through the urethra and out through the fistula, hooking up the fistula and bringing it into the field.

The Classical Operation.—This consists in paring the edges and suturing them without splitting them.

If the exposure of the fistula be made difficult by cicatricial bands the first step is to divide these with scissors and stretch the vagina with retractors. It is of no use to pare the edges unless they will come easily together afterwards, without undue tension. In case of great difficulty in obtaining access to the fistula modern operators sometimes employ Schuchardt's method of paravaginal section as used in his operation of vaginal hysterectomy.

Paring the Edges.—Various knives have been designed for the purpose and some have the blade set at an angle like a cleft palate knife, but a small sharp scalpel will answer very well. To attempt to cut the soft yielding tissues with any but a perfectly sharp blade will imperil the success. A pair of sharp, fine, curved scissors is useful, and one also needs fine volsellae to steady the vaginal wall and fine-nibbed dissecting forceps. A stream of sterile water may be used to irrigate the field of operation and keep it clear from blood. An incision is made all round the fistula with the scalpel. The incision is not made at right angles to the septum, but is carried obliquely inwards through the whole septum except that the vesical mucosa is not cut away. It is best to remove the strip of tissue in one piece if possible. The incision may be carried half way through with the knife and finished with the scissors. The freshened edge should then measure at least one-third of an inch across. If any part be left unfreshened union will be imperfect. If there be thickened cicatricial tissue at the edge, this must be cut away. Operation on small fistulae has often failed because the denudation has been too sparing. Bleeding is usually not severe and can be stopped by hot douche and pressure. When the freshening is complete the edges should come easily together. If they do not, incisions made in any tense bands in the vaginal mucosa may remedy this. It is absolutely essential for success that tension on the sutures should be avoided.

When the fistula is denuded it should present a crater-shaped appearance with the wider side on the vaginal aspect as in Figure 257.

Suturing the Edges.—If the fistula be circular the line of suture should be in the transverse axis of the vagina, but that direction is best in which the edges will meet most easily. The wound may have to be oblique or irregular, but it is well to avoid a wound that has angles such as occur in Y-shaped, X-shaped, or H-shaped wounds. It is very important to have complete apposition throughout the whole thickness of the wound and to avoid puckering. The sutures must take a good hold of the edges, they should not be more than 4 or 5 to the inch, and they must not be tied very tightly or sloughing will follow. It has usually been insisted on that the sutures should not pass through the vesical mucosa but probably this does not matter very much; but it is important that no length of suture should be exposed on the vesical side lest calculous material should be deposited there subsequently.

Material used in Suturing.—The older operators attributed much of their success to the use of silver wire, but silkworm-gut will do equally well and is easier to pass. These non-absorbable sutures have to be removed later, for if they are cut short and left they are apt to migrate into the bladder and become the nuclei of calculi. Catgut is likely to soften too soon and is not suitable for this classical operation.

Various needle-holders have been devised for the operation, but full curved Hagedorn's needles on Hagedorn's holder, or Mayo's needles on Mayo's holder will answer well. It is not always easy to pass wire sutures through the yielding edges; Sims and Emmet passed silk sutures first and used these to draw the wire through afterwards. There is no special difficulty in passing fine silkworm-gut. When wire is used it may be secured by twisting. Superficial sutures may be passed between the deeper ones as in Figure 257. When the operation is finished the wound may be tested by injecting water into the bladder. The operation concludes with the introduction of a self-retaining catheter.

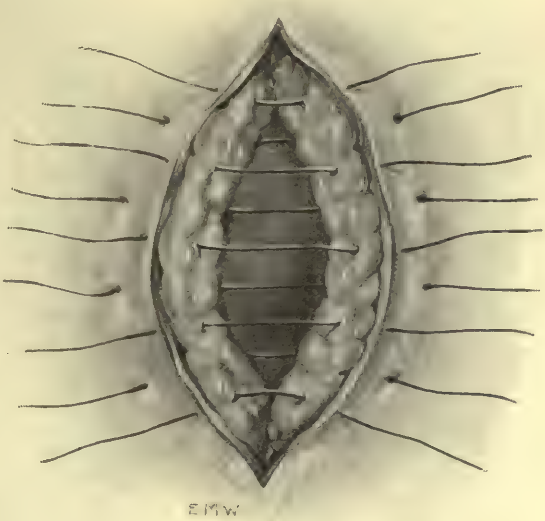

FIG. 257.—The classical operation for vesico-vaginal fistula.

The Method of Repair by Flap-Splitting.—We believe this to be the best operation for ordinary cases. It is easy to carry out, involves little or no loss of tissue, and yields excellent results, while its principle is capable of extension in dealing with severe cases. The following illustrations will make the steps of the operation clear.

With a very sharp scalpel an incision is carried round the edge of the fistula separating the vaginal wall from the bladder. The incision is carried a little above and below the fistula as shown in Figure 258. The separation should be begun just above the edge of the fistula, and this avoids the possible error of separating the vesical mucosa from the muscular layer instead of the whole bladder wall from the vagina. In making the separation it is a good thing to lay the scalpel down and complete the undermining with scissors as in Figure 258. By gently drawing the vesical edges together it will be seen whether they meet without tension, and the vaginal wall may be further separated if necessary till this is secured. After the flap-splitting is com-

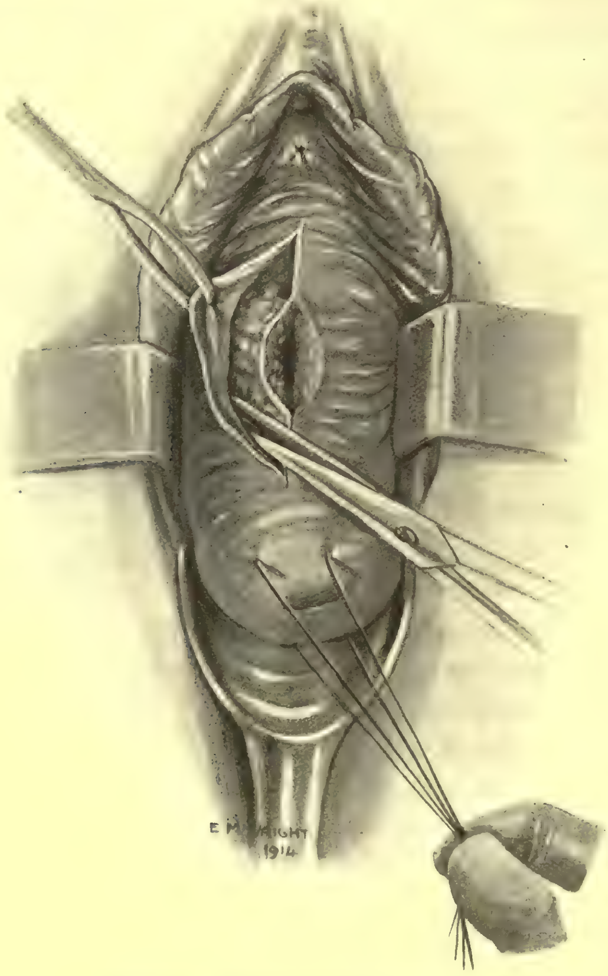

Fig. 258.—The flap-splitting operation.

pleted little further freshening is needed, but the vesical edge may be trimmed with sharp scissors where it seems desirable. The bladder is now sutured with thin iodized catgut or with whatever absorbable material the operator prefers (see Fig. 259). The suturing may be tested by injecting water into the bladder. The vesical sutures are then cut short as in Figure 260. Some further sutures may be passed in Lembert-fashion outside the first row as shown at *a* in Figure 260, these being likewise cut short. Lastly the vaginal wall is sutured by silkworm-gut or sutures of stout catgut that will hold for at least fourteen days (Fig. 260, *b*). The line of vaginal sutures may correspond with that of the bladder sutures, or may be at right angles to it if this

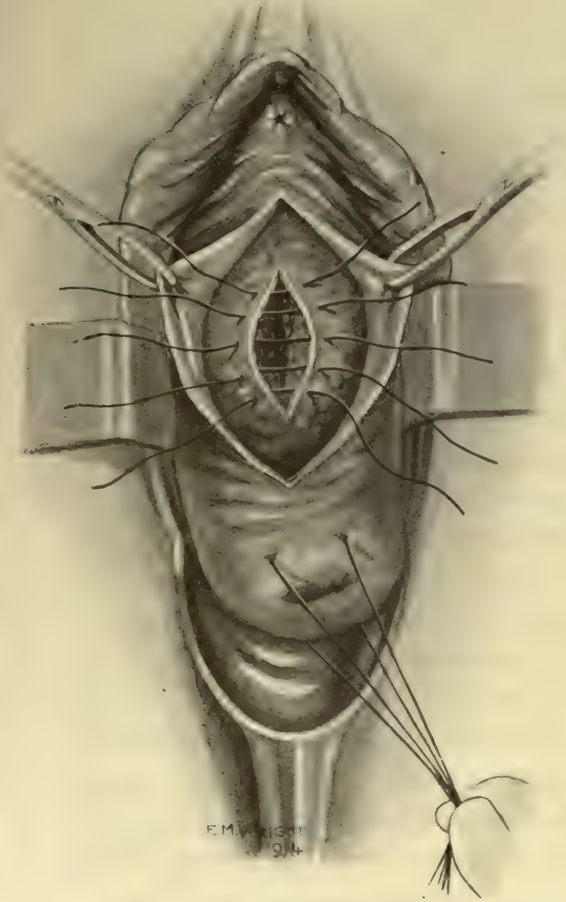

Fig. 259.—Suturing the bladder in the flap-splitting operation.

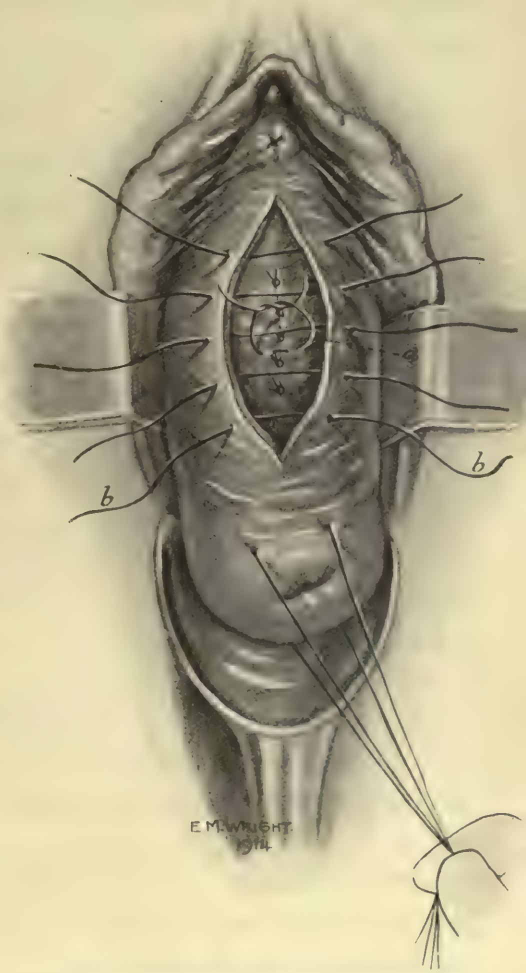

Fig. 260.—Suturing the vagina in the flap-splitting operation.

does not pucker the wound. If the vaginal flaps are loose enough they may be joined by mattress-sutures passed a little distance outside the edge so as to make a slight keel in the middle line and broaden the apposed surfaces. It is very important to draw none of the stitches too tight. The writer prefers interrupted to continuous sutures in this operation, which concludes with the insertion of a catheter (see later). In a small fistula the vesical opening may be secured by a purse-string suture.

When the edges of the fistula are bound down to the pubic bone we are faced with a difficult complication. An attempt must be made to undermine the edges with a sharp scalpel till they are sufficiently free for suture. The paravaginal incision of Schuchardt may be used to gain access to the fistula, and it is a very valuable expedient in difficult cases. Fritsch made a suprapubic incision for the purpose of dissecting the edges, but found that there is then danger of wounding the bladder.

When the ureteral orifice lies in the edge of the fistula it is of the first importance to recognize this in order to avoid occluding the ureter in the operation. The first step is to catheterize the ureter and carry the catheter out through the urethra. Then in a flap-splitting operation the bladder wall is well separated and the edge turned upwards into the bladder and the sutures passed carefully avoiding the track of the ureter. In an operation by simply paring the edges of the vesico-vaginal septum the freshening must be carried well outside the ureteral orifice with a good margin.

Vesico-Cervical Fistula.—In a pure vesico-cervical fistula Simon found the urine flowing from the *orificium externum*, and he closed the cervix so that afterwards menstruation occurred *per urethram*. There can be little doubt that the proper way is to make a transverse incision across the anterior fornix and separate the bladder till the fistula is completely detached, and then suture it and also the cervical aperture separately. Then the vaginal wall is sutured to the cervix. Champneys was one of the first to adopt this method.[1] He used buried silver-wire sutures, but catgut is more suitable.

J. F. Dobson of Leeds has kindly furnished notes of the following hitherto unpublished case of vesico-cervical fistula in which the urine discharged through the os externum. The cystoscope showed the ureteral orifice to be so close to the fistula that it was thought wise to catheterize the ureter to protect it. The anterior fornix was opened and the bladder stripped from the cervix. The opening into the uterus was situated somewhat laterally and evidently was due to a tear which had healed below but not above. He then split the cervix and repaired it from above downwards. The bladder was closed with two rows of sutures not involving the mucosa. The uterus was then pulled down and the bladder sutured to it above and below the former opening with one or two points of catgut.

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[1] See *Trans. Obst. Soc. Lond.* vol. xxx. p. 384.

On the Treatment of more difficult Cases.—The literature of the subject contains many interesting records of the various plans that have been adopted to deal with cases where the defect in the vesico-vaginal septum is so great that there is not sufficient cover obtainable by the operations already described, or where the fistula is situated so high that special dissection is needed to make it accessible.

If there be no vaginal wall left between the distal edge of the fistula and the cervix uteri the anterior lip of the cervix may be freshened and united to the anterior portion of the fistula, also freshened thoroughly, and the cervix may be divided bilaterally to facilitate this. Sometimes the anterior lip is so defective that this is impracticable. In such a case some operators have freshened the posterior lip of the cervix and have then united this to the anterior edge of the fistula, so that the uterine canal thenceforwards opens into the uterus and menstruation, if still present, takes place by the bladder and urethra. If such a step be proposed it should be explained to the patient beforehand, but it may be said that vesical menstruation does not appear to have involved any special complication except subsequent sterility.[1]

But the principle of flap-splitting can be extended so as to deal with some of these cases. Mackenrodt of Berlin published an article in 1894 [2] in which he describes such a method. He divides the anterior vaginal wall from near the meatus urinarius to the cervix, then splits the edges of the fistula and separates the bladder as far back as necessary, even to the vesico-uterine fold of peritoneum, till the bladder is so free that the edges of the fistula can be approximated either by anteroposterior or lateral application as may be found best. He then freshens the bladder edge with sharp scissors and sutures it. Next the vaginal edges are freshened. Now the corpus uteri is drawn forwards as in the operation of 'interposition' (p. 631) and is fixed to the vaginal edge. If the edges meet easily they are joined, but if not they are sutured to the anterior uterine wall so that the front of the uterus appears in the vagina when the operation is completed, closing the defect in the vaginal wall. It soon assumes the appearance of ordinary vaginal mucosa.

Howard Kelly records a very interesting case in which there was a large defect in the vesico-vaginal septum. He separated the bladder from its posterior attachments, and sutured the anterior and posterior edges of the vesical fistula but did not close the vaginal wound, leaving it to granulate and cicatrize. This it did very satisfactorily, thus proving that in such a plastic operation it is not absolutely necessary to close the vagina.[1] Dudley, in a similar case, drew a fold of the bladder forwards, and after freshening it sutured it to the anterior edge of the fistula so that that part of the vesical mucosa which was behind the sutured fold formed part of the new vaginal wall.[2]

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[1] See Emmet, *op. cit.*

[2] *Cent. f. Gyn.*, 1894, No. 8.

Freund in 1895 devised a method of closing very extensive vesico-vaginal fistulae by bringing the uterus through the posterior vaginal fornix in a retroverted state; he then freshened the edges of the fistula and the posterior uterine wall and sutured the uterus to the edges of the fistula so as to close it. He then made an opening in the fundus uteri to allow the escape of menstrual discharge. This operation has been repeated by others, as for example by Fromm and Kahn of Wilna.[3] In one of these cases there was some tendency to necrotic processes in the uterine wall after it had been sutured in its new position. Certainly Freund's operation is a possible method of dealing with extreme cases, and is at all events an improvement on treatment by occluding the vagina (colpocleisis) of which we speak later.

Some other forms of flap-operation have been adopted at various times: flaps have been cut from the vulva and labia minora, but not with great success. Trendelenberg transferred a flap from the posterior vaginal wall.[4] An operation by Martin should be noted. He closed a vesico-vaginal fistula of fifteen years' standing, which twice before had been unsuccessfully operated on. Instead of cutting flaps by splitting the edge of the fistula he made incisions parallel to the edges but at a little distance from them, and then turned these flaps inwards towards one another. When these were sutured the former vaginal surfaces of these flaps became the new floor of the bladder, the raw surfaces being turned downwards towards the vagina. The vaginal edges were then closed over these inverted flaps.[5]

Transvesical Operation.—Trendelenberg was the first to describe an operation for vesico-vaginal fistula performed by suprapubic cystotomy.[6] The late A. F. McGill of Leeds, who was also a pioneer in prostatectomy, recorded two cases thus treated.[7] The patient was placed in the Trendelenberg position, the bladder was opened and temporarily sutured to the abdominal wall, and a small electric lamp was placed in the bladder. When the hand of an assistant, passed into the vagina, elevated the floor of the bladder it was found to be very easy to freshen and suture the fistula. The patient was next placed in the lithotomy position and four silk sutures were passed on the vaginal side. Then the bladder and abdominal wound were closed, leaving central suprapubic drainage. Perfect cure followed. In this case the fistula was situated just in front of the cervix and admitted the tip of the index finger. Other operators have had similar success, and the method may be regarded as an occasional expedient.

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[1] Kelly, *Operative Gynaecology*, 1906, p. 430.

[2] Kelly, *op. cit.* p. 429.

[3] See six cases published in the *Centralbl. f. Gynäk.*, Feb. 18, 1899.

[4] *Samml. klin. Vorträg*, No. 355, 1890.

[5] A. Martin, *Zeitschr. f. Geb. u. Gyn.*, No. 119, p. 394.

[6] *Samml. klin. Vorträg*, 1890, No. 365.

[7] *Trans. Clinical Soc. Lond.*, Nov. 3, 1890.

Transperitoneal Operation.—Von Dittel was one of the first to deal with a high fistula by opening the utero-vesical fold of peritoneum by abdominal section, separating the bladder from the uterus and suturing the fistulous openings separately, subsequently closing the peritoneum. A. Giles, in an unpublished case, dealt with a vesico-vaginal fistula left after panhysterectomy for carcinoma where a vaginal operation had failed to close the fistula. He opened the abdomen, separated the bladder, and closed the fistula, employing a retained catheter in the after-treatment, and the patient made a perfect recovery.

Transperitoneo-vesical Method of Legueu.—Brief reference should be made here to a method of operating recently described by Legueu.[1] He opens the peritoneal cavity, inserts a retractor, packs off the field of operation, and then divides the posterior wall of the bladder by a median incision nearly to the vagina. This bold incision exposes the fistula more freely than any other operation. The bladder is then separated from the vagina by a flap-splitting operation (*dédoublement*). The bladder wall is then sutured in layers and the vaginal opening is closed also. Then the vesical wound, and if possible the vagina also, are carefully covered with peritoneum so that the two organs are completely separated. Legueu considers that for post-operative fistulae after hysterectomy and for fistulae which are seated very high this operation will offer great advantages, and that it is better than the extraperitoneal transvesical operation already described. How great risk is involved of peritoneal infection remains to be decided, but the operation seems worthy of full consideration in the fistulae of the more inaccessible class.

Urethro-Vaginal Fistulae.—When these are small they can be closed by freshening the edges and suturing as in the classical operation for vesico-vaginal fistula.

When the urethra has been so extensively destroyed that this method is impracticable, flaps may be dissected from the labia minora or from the vaginal wall so as to construct a new urethra. This operation is done in two stages. The urethra is first restored except at the upper end where the fistula temporarily is left open. When the new urethra has healed, a second plastic operation is performed to complete the closure.[2]

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[1] See Labadie-Lagrave et Legueu, *Traité Médico-chirurgical de Gynécologie*, ed. iv. p. 292, where full illustrations are given.

[2] *Ibid.*; also Lawson Tait, *Obstetrical Journal*, 1878, vi. 95.

Ureteral Fistulae.—Ureteral fistulae are occasionally congenital. In such cases the ureter will be found opening independently on some part of the vesico-vaginal septum or by the side of the urethra.

Ureteral fistulae of puerperal origin may as already said form part of a vesico-vaginal fistula, or they may open directly into the vagina. They are not common and occur in that part of the ureter which lies in the bladder wall. A cervico-ureteral fistula is probably the consequence of a larger fistula which has not perfectly healed. Ureteral fistulae have occasionally been caused by ulceration from a pessary, or by malignant disease, or by a ureteral calculus, or by some operation, such as incision of a pelvic abscess. But the most common causes of ureteral fistulae to-day are accidental injury, such as tearing, or clamping the ureter during vaginal or abdominal pan-hysterectomy for cancer, or localized necrosis resulting from interference with its blood-supply.

Diagnosis.—Congenital ureteral fistulae are distinguished by their situation, and by the fact that the incontinence is present from birth.

In ureteral fistulae incontinence exists side by side with normal micturition, and if the bladder be injected with coloured fluid this will not escape through the fistula. The fistula is usually situated laterally.

To diagnose which ureter is affected little regard must be paid to the position of the fistulous opening in the vagina, for this is fallacious as a guide. The affected ureter often becomes stenosed below the fistula and dilated above it, and on bi-manual examination the thickening of one ureter can sometimes be made out. The diagnosis can be safely made only with the cystoscope and ureteral catheter. The wounded ureter does not discharge into the bladder and the catheter will not pass up it.

Prognosis.—Ureteral fistulae have a considerable tendency to close spontaneously provided that the fistula is lateral and partial. If the ureter be completely divided the fistula will not heal spontaneously. After six weeks an unhealed fistula has but little likelihood of healing.

Operative Treatment of Uretero-Vaginal Fistulae.—For some time after methods had been introduced for the repair of ordinary vesico-vaginal fistulae, uretero-vaginal fistulae were still regarded as being beyond the reach of surgery. Several surgeons have, however, in recent times carried out successful operations. Such operations are difficult. It is not easy to repair the ureteral leak and yet leave the ureter perfectly unobstructed, and subsequent stenosis may impair an operation that at first seemed quite satisfactory. If anything in the way of a pouch or pocket be formed at the seat of operation calculous concretion may be found there later. If a ureteral operation be followed by suppuration there is some considerable danger of ascending infection. Those who have recorded successful cases have frequently done so only after one or more unsuccessful attempts.

Without attempting an exhaustive account of all the methods that have been advocated we will give some examples of operative procedures by which success has been obtained. Pozzi performed one of the simplest operations in a case of uretero-vesico-vaginal fistula where eleven previous operations had failed.[1] He made a transverse incision at the level of the fistula extending beyond it on either side for about 1 cm. A vertical incision at each extremity gave this the shape of an H. By dissection at the transverse incision he split the septum at half its depth, and thus raised two small flaps each about 1 cm. long upwards and downwards respectively. When these were raised the small orifice of the fistula was seen in the centre of the raw surfaces. It was then easy to draw the two flaps together by three deep silver-wire sutures and three superficial sutures. The cure was complete. In this operation there was no loss of tissue. It is obvious that this operation is suitable only for certain cases, and in this case there was already an opening into the bladder.

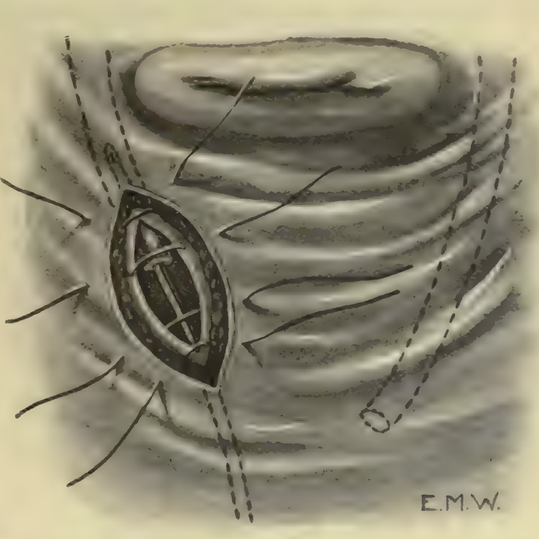

FIG. 261.—Landau's operation for uretero-vaginal fistula.

Simon [2] introduced the principle of converting a uretero-vaginal into a uretero-vesico-vaginal fistula as a first step towards cure, and this plan has been adopted by others with various modifications. Simon made a vesico-vaginal opening close to the fistula and then catheterized the ureter. He then cut down on the catheter from the vesical side, thus increasing the size of the ureteral opening. To prevent this from stenosis he passed the ureteral catheter for several days. Finally he closed the fistula. Landau [3] described an operation illustrated in Figure 261. If no vesical fistula be present one is made by excision of an oval strip of the septum. The ureter is then catheterized, the catheter being brought out *per urethram*. The vaginal mucosa is next freshened all round the ureteral fistula and sutured as shown in the figure. The catheter is left *in situ* for several days.

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[1] It will be found described in his *Traité de Gynécologie*. See New Sydenham translation, 1893, vol. iii. p. 285.

[2] *Wiener med. Wochenschrift*, 1876, No. 28.

[3] *Archiv für Gynäkol.*, 1876, vol. ix. p. 426.

Dührssen[1] described an operation performed by him which is illustrated in Figures 262 and 263. V, V show two flaps of vagina reflected left and right after making an incision 4 cm. long extending above and below the uretero-vaginal fistula (U, V, F). He then made an opening into the bladder as shown at B, B, the ureter being previously catheterized. The dotted lines show the position of the ureter. The ureter was then split up for about 6 mm., and its patency was secured by suturing the split edges to the vesical mucosa. Lastly the bladder and vagina were sutured as shown in Figure 263.

The ultimate result was excellent, and the ureter functioned normally.

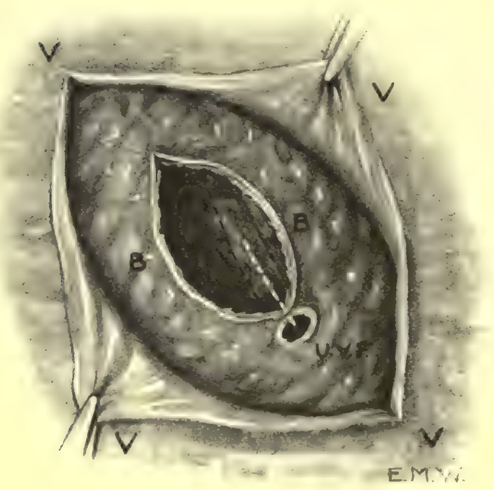

FIG. 262.—Dührssen's operation.

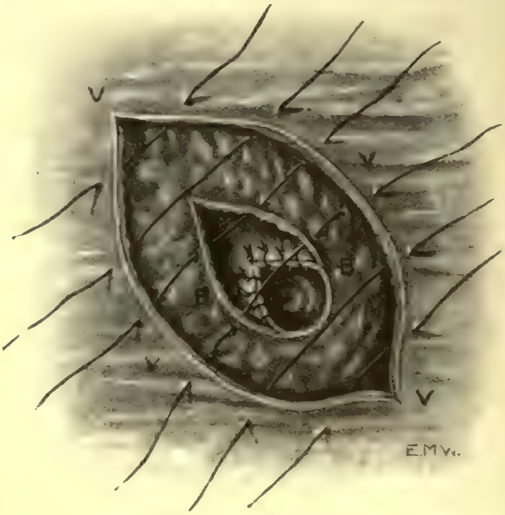

FIG. 263.—Dührssen's operation.

Mackenrodt described an operation twice successfully carried out by him.[2] It appears complicated but he declares it is simple to perform. He made an artificial fistula into the bladder near the ureteral fistula. He next dissected around the ureteral orifice a peri-ureteral flap of vaginal wall which contains the ureteral end. He then separated the vaginal wall from the bladder by flap-splitting, and turning the peri-ureteral flap over with its epithelial surface looking into the bladder he sutured the edges of this flap to those of the vesical fistula so that the flap covered the fistula. The vaginal wall was then closed over in two stages. Pfannenstiel operated successfully in similar manner.

Bumm made a vesico-vaginal fistula close to the ureteral fistula, and then placed a

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[1] *Samml. klin. Vortrag*, 1894, No. 114.

[2] An account will be found in *Zeitschrift für Geburtshülfe und Gynäkologie*, Band xxx. 894, with very clear diagrams.

Dupuytren's bowel clamp with one blade in the ureter and one in the bladder. When the consequent sloughing had made a free communication between bladder and ureter he closed the vesico-vaginal opening by plastic operation. Dudley[1] described a similar operation.

The above illustrate sufficiently the way in which treatment may be adapted to individual cases. No two cases are alike, and it is not possible to describe any operation of universal application.

Ureteral fistulae that cannot be reached by the vagina may be treated abdominally. Uretero-ureteral anastomosis has been attempted by some, but this operation is more suitable for dealing with a recently-divided ureter in the primary operation than for a fistula following necrosis. The best abdominal operation is probably the re-implantation of the ureter into the bladder. We will quote here the directions for this operation which are given by Stöckel,[2] for much success has followed it in his hands and in those of others. Cuthbert Lockyer, for instance, has recorded successful cases. See *Brit. Med. Journ.*, 1908, vol. ii. p. 797.

Let us assume that the fistula has followed a hysterectomy. The patient is placed in the Trendelenberg position, and the abdomen is opened in the middle line. Adhesions will probably be present in the pelvis and these must then be separated till the pelvis is clear. The ureter must then be found and it will probably be thickened. The peritoneum is then divided over the ureter beginning below the division of the external and internal iliac vessels. Holding the two layers of peritoneum apart the ureter is traced along the posterior peritoneal layer as low as possible. It may need to be shelled out of its cellular sheath. The distal end of the ureter is also raised. The ureter is then cut, clamped, and drawn up. The distal end does not need ligature. Now comes a very important step. A portion of the lateral wall of the bladder nearest and most accessible to the ureter is drawn gently upwards and fastened with catgut sutures to the peritoneal edge so that the small portion of bladder passes under the ureteral end which lies gently on the bladder without traction. Then a suitable instrument is passed *per urethram* into the bladder to the point in the bladder which is to be opened (a rubber catheter with stylet would do), and a small opening is made just large enough to admit of the ureteral end being pulled through. This is done with a loop of thread (untied) passed through the ureteral wall and carried out *per urethram* by the carrier instrument. The ureteral end is then drawn into the bladder till about 1 or 2 cm. project into the bladder. Three fine catgut sutures then unite the ureter to the bladder wall. The bladder now has a portion lying like a cushion under the ureter, and the anterior surface of the bladder is next drawn up over the ureter where it is uncovered by peritoneum so that a cuff of bladder completely surrounds the implanted ureter. The abdomen is then closed and a catheter is left in the bladder. The pilot thread is drawn out at this point or may be secured to the thigh by strapping. The ureter may not act fully at first but will do so as swelling due to oedema subsides.

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[1] *Principles and Pract. of Gynaecol.*, 1905.

[2] *Veit's Handbuch der Gynäkol.* Bd. ii. 578.

Stöckel says he has thus operated on 15 cases without a bad result.

After-Treatment of Operations for Fistulae.—In order to prevent distension of the bladder after operation a catheter must be left in the bladder. This is better than systematic catheterization which some have preferred. Sims designed a self-retaining catheter of metal, but one of the patterns of self-retaining rubber catheters now on the market, such as Dowse's, is usually employed. The catheter is introduced just sufficiently far enough to draw off the urine, and one wants to avoid leaving the catheter in contact with the sutured wound. Fritsch advises that after operation water should be injected into the bladder, and the catheter introduced till it begins to act and then fixed in position with strapping or suture. The catheter must be kept clean, being withdrawn once or more every day and boiled before reinsertion. If the urine becomes thick or there is any cystitis it is good practice to wash out the bladder very gently with funnel and siphon, using a saturated solution of boric acid for this purpose. If there be vaginal discharge the vagina should be douched with a solution of lysol or of permanganate of potassium. The catheter is removed in a week. The patient is kept on light diet and at the end of a week a dose of castor-oil is given, followed by an enema. The stitches if of wire or silkworm-gut are removed in ten days.

After operations for fistulae relapses have been known to follow premature straining or exertion. Schuppert saw a case give way 19 days after operation because heavy work was attempted. Premature resumption of conjugal relations has caused similar damage. The general health will usually improve greatly after successful operation. If there be amenorrhoea suitable emmenagogues are given.

The dangers of the operation are not very great in ordinary vaginal methods. Haemorrhage may occasionally give trouble. Bäcker of Buda Pesth[1] saw a death in a case of a patient aged 29 in whom a "high colpocleisis" had been performed. Three and a half hours after operation the bladder was full of blood and urine, reaching to the navel. While it was being examined the patient strained violently and ruptured the bladder. The patient died 45 hours after the operation, and there were found on autopsy spontaneous subperitoneal rupture of the bladder with subperitoneal haematoma and phlegmon, and acute sepsis. Simon had a death from pyaemia on the tenth day. Emmet saw a death from pyaemia and one from uraemia, and others have had occasional fatalities.

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[1] *Centralbl. f. Gynäkol.*, 1893, No. 38.

Failure may result from suppuration, and occasionally flaps may slough; but even if the operation be not a complete success it may be found that the fistulous opening is much diminished in size, and many such cases have been cured by subsequent operations.

After cure of the fistula it may be found that the bladder has shrunk and can hold very little urine, but fortunately in most cases the bladder recovers its function almost completely. The urethra may also need treatment by dilatation. Sometimes there is at first some degree of incontinence remaining, due to incompetence of the sphincter. This also tends to improve with time. If there be any cystitis systematic irrigation of the bladder will benefit most cases rapidly.

Derniers Ressorts.—It still remains to consider what can be done in cases where urinary fistulae cannot be closed by any method hitherto described.

For inoperable fistulae Simon and Bozeman independently adopted the plan of closing the vagina (colpocleisis) so that there is formed a common receptacle in which urine, menstrual fluid, and any other vaginal discharges are collected. Simon first performed it in 1855. The vaginal mucosa is denuded in a strip all round the canal and the raw surfaces are sutured. It may be performed at a low level or as high as the situation of the fistula will allow. This operation has since been strongly condemned by those who have had much experience of it. The relief is only temporary, for local symptoms arise and become very distressing. The mixed fluids collected in the vagina become septic. The urine becomes thick and offensive and cystitis arises. Moreover, there is a tendency for urates and phosphates to collect and form concretions, and large calculi have thus been formed in the vagina. Ascending infection may reach the ureters and kidneys and ‘ surgical kidney ’ may result. Ascending septic infection may invade the uterus and tubes, so that the last state of the patient is worse than the first. Some women have even resented the occlusion of the vagina for conjugal relations. Fritsch declares that “ a successful colpocleisis is an irreparable injury to the patient and practically amounts to manslaughter.”[1] Fritsch thought it was better to make an artificial recto-vaginal fistula and then perform a colpocleisis. But it is not easy to keep the fistula open.

Another expedient that has been considered is to implant both ureters into the bowel. It is not very difficult to implant the right ureter into the caecum and the left into the sigmoid flexure of the colon, but it is a dangerous operation, for ascending infection is likely to reach the kidney, and the writer has heard of a case where the operation was performed in a male patient who died from suppression of urine.

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[1] Stöckel, in *Veit's Handbuch.*

If the part of the bladder wall which contains the ureteral orifices be implanted into the bowel the ureters are not deprived of their self-protecting mechanism, and the danger of ascending infection is very much less. Lawford Knaggs of Leeds published in the *British Medical Journal* for May 21, 1910, a case of inveterate vesico-vaginal fistula in which he operated by the sacral route, implanting the vesical ends of the ureters into the rectum, removing the uterus to facilitate this. The relief obtained in this very interesting case was very encouraging. He had similar success in a case of extroverted bladder.[1]

A last resource for incurable *ureteral* fistulae is nephrectomy, but it is a point worthy of consideration whether ligation of the ureter may not be a legitimate expedient in certain cases. (See a very interesting article on "Experimental Ligation of One Ureter," by W. Clinton Jones of Chicago, *Amer. Journ. of Obst.*, September 1914, page 396.)

FAECAL FISTULAE: RECTO-VAGINAL FISTULAE

Causation.—As with urinary fistulae the cause may be puerperal. The commonest manner in which recto-vaginal fistula is produced by labour is the rupture of the perineal body into the rectum followed by partial healing, which closes the anterior portion but leaves a rectal fistula posteriorly. Such a fistula is usually very superficial and is rather ano-vaginal than recto-vaginal.

With this exception damage to the recto-vaginal septum is not a frequent result of impacted labour or of the unskilled use of instruments, although there have been flagrant exceptions. Malignant disease of uterus, vagina, or rectum is often complicated with rectal fistula in later stages. Strictures of the rectum, syphilitic or otherwise, may have this complication, and an abscess in the pouch of Douglas or recto-vaginal septum may point in both directions. Foreign bodies in the vagina, such as have already been mentioned as liable to ulcerate into the bladder, may also penetrate the rectum, and a Zwanck-Schilling pessary furnished an example which came under the writer's observation. A remarkable case is recorded by Segond [2] where a girl, by introducing a pomatum pot into the vagina, caused a recto-vaginal fistula so that ultimately the whole posterior fornix was found to open into the rectum.

Occasionally trauma has been the cause as in criminal assaults on young girls and old women. R. S. Dobbin has informed the writer that in Egypt recto-vaginal fistulae are not unfrequently due to the local custom of artificially breaking down the hymen before the first coitus, for this proceeding is often carried out in so rough and unskilful a manner that the recto-vaginal septum is torn through and a fistula produced.

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[1] *Brit. Med. Journ.*, October 24, 1908.

[2] *Ann. de Gyn. et d'Obst.*, 1895, t. xliv. pp. 1-14.

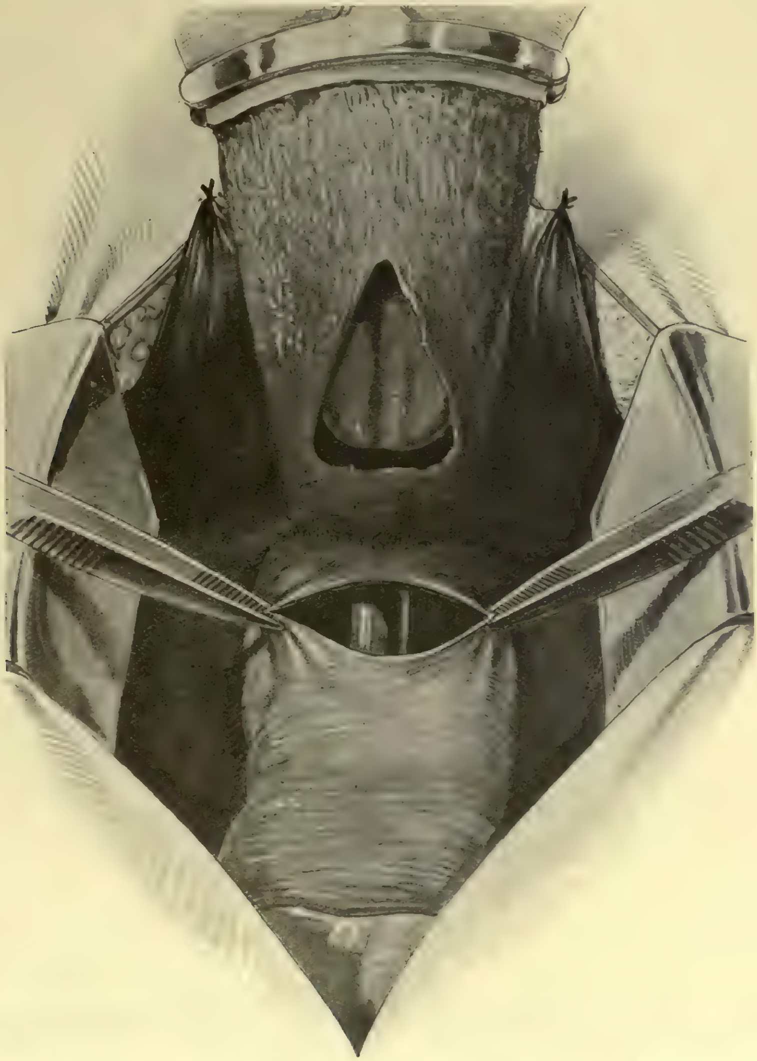

Fig. 264.—Diagram to illustrate Eden's operation for recto-vaginal fistula. The uterus and vagina are drawn up and the rectum is dissected away from the vagina. The rectal opening is held up by forceps, the cervix uteri is seen through the vaginal opening.

Certain congenital defects may cause a fistulous communication between the rectum and vagina, as will be found described in another part of this work (Vol. I. p. 272). Lastly, mention must be made of post-operative fistulae caused by accidents during gynaecological operations, such as posterior colporrhaphy, posterior colpotomy, and operations by the vaginal route for pelvic tumours, especially those complicated by adhesions to the bowel, such as pyosalpinx.

Entero-vaginal fistulae may form between the vagina and the bowel above the rectum by the pointing of intraperitoneal abscesses whether appendicular or otherwise.

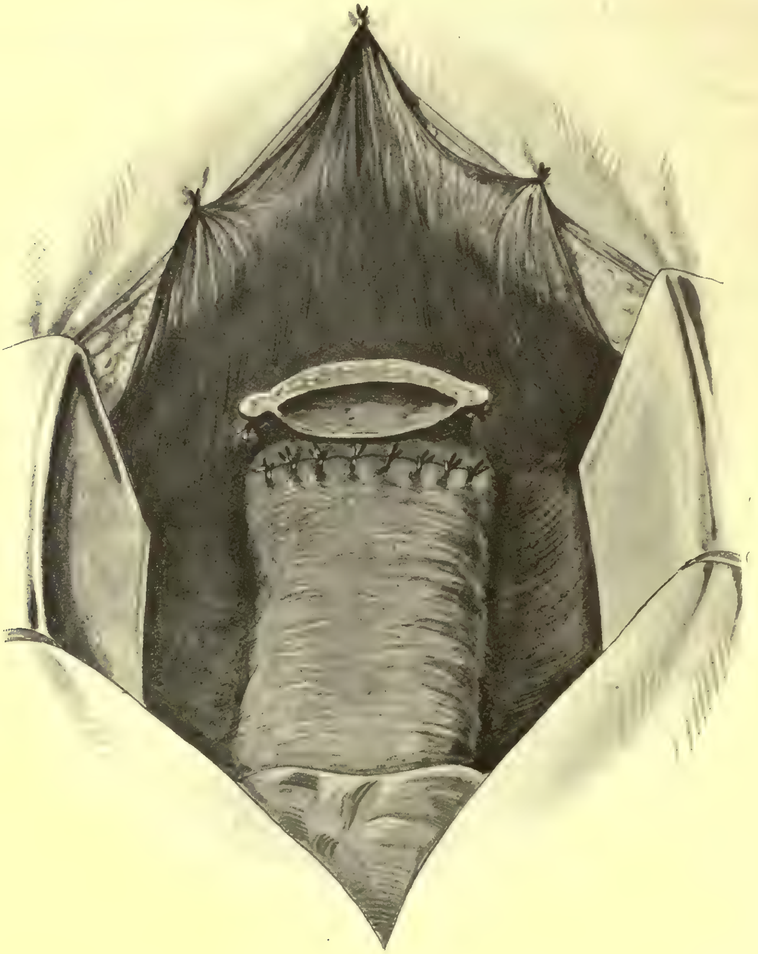

Fig. 265.—Further stage in same operation.
The rectal opening has been closed by sutures and the uterus has been amputated.

Symptoms of Recto-Vaginal Fistula.—The two symptoms to be mentioned are incontinence of faeces and of flatus. Some women are so constipated that even when there is a recto-vaginal fistula there may be little incontinence of faeces, but the unrestrained passage of flatus gives annoyance, and there is usually a faecal odour about the person. Only in very small fistulae is it necessary to use injections of coloured fluid for diagnosis.

Treatment.—There is a considerable tendency for recto-vaginal fistulae when recent to close spontaneously. Before any operation, it is wise to dilate the sphincter ani very thoroughly to produce temporary incontinence and thus prevent distension of the rectum during the healing of the wound.

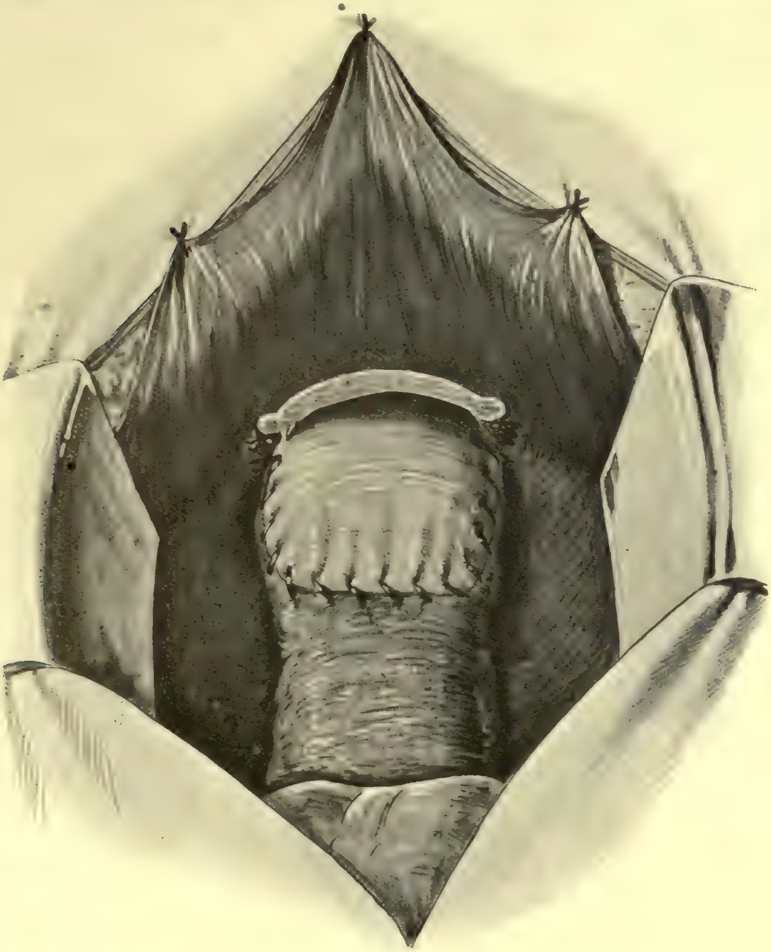

Fig. 266.—Further stage in same operation.
A flap from posterior vaginal wall has been stitched to the rectum so as to cover the site of the rectal fistula.

Fistulae left by imperfectly healed perineal rupture are best treated by dividing the perineal bridge and performing an ordinary flap-splitting perineorrhaphy. The bridge divided is trivial in extent, and the attempt to preserve it would hinder the building up of a substantial perineal body.

Small rectal fistulae may be treated by simple paring and suture, but for fistulae in the lower third of the posterior vaginal wall there is a better plan in most cases. This is to make a transverse incision across the perineum and then separate the posterior vaginal wall upwards to and a little beyond the fistula. The rectum is pushed back and the opening in the bowel is sutured. Then the perineal body is built up with successive buried catgut sutures. The writer prefers to make a median incision in the separated posterior vaginal wall. This facilitates the exposure of the fistula and the building up of the perineal body. It is possible to suture the levatores ani together over the rectal wall as in ordinary colpo-perineorrhaphy, and the resulting operation is very satisfactory.

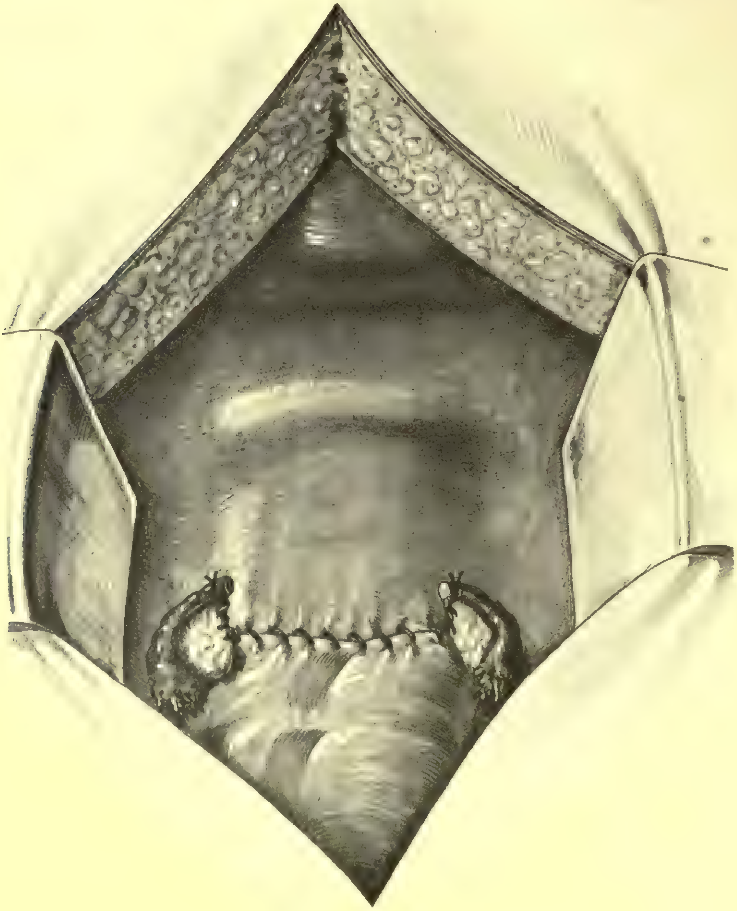

FIG. 267.—Further stage in same operation.
The peritonization of the pelvic floor has been completed by stitching the anterior vaginal flap to the rectum.

For larger fistulae we have another operation available. The rectum can be dissected from the vagina till the lower segment including the fistula is fully exposed. A sufficient portion of the bowel is then excised so that the upper edge can be brought down and sutured at the anus, very much as is done in excising a carcinomatous growth localized in the anterior rectal wall just above the anus.[1] Thus the sutures are below the vaginal opening caused by the fistula, and the vaginal wall is sutured separately. This operation was performed by Segond in dealing with the fistula referred to above as caused by the ointment pot. He excised an unnecessarily large portion of the rectum. It is necessary only to excise the part containing the fistula and the bowel wall between that part and the anus. Dudley and von Herff have contributed to the evolution of this operation. In all these operations one must not be afraid to free the gut fully so as to avoid all tension.

Abdominal Operation.—When the fistula is high up and above the middle of the vagina it has been shown lately that full access to the fistula may be obtained successfully by an abdominal operation with transperitoneal dissection. A very full and clear account of this method will be found in a paper by T. W. Eden in the *Proceedings of the Royal Society of Medicine*, 1914, vol. vii. (Obst. and Gynaecol. Section), pp. 243-260, which is illustrated by very clear diagrams. The condition was of puerperal origin, and there was a recto-vaginal fistula at the posterior fornix through which the tips of two fingers could be passed into the rectum. The operation included a preliminary colostomy which greatly helped its successful accomplishment. About twenty days later, abdominal section was performed, the uterus was removed *in toto*, and the rectum was separated from the vagina to a point well below the fistula. The fistula was sutured and a flap of vaginal wall made to cover the sutured part, and finally the peritoneum was sutured over the rectum and made to cover in the pelvic floor. The vagina was left open below for drainage. There was partial giving way of the rectal sutures in the after course, but ultimate healing took place, and the continuity of the bowel was secured by a subsequent operation at the seat of the colostomy. Figures 264-267 illustrate the principal stages of Eden's operation.

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[1] This operation is described on page 270.—EDITORS.

MINOR UTERINE OPERATIONS

By Victor Bonney, M.S.
(London)

Dilatation of the Cervix

Indications.—Dilatation of the cervix may be indicated as a method of relieving certain forms of dysmenorrhoea or of increasing the chances of impregnation. It is also employed to gain access to the uterus for exploratory purposes, or as a preliminary to curettage, the removal of the products of conception, or the ablation of polyps or other intra-uterine growths.

Previous Preparation of the Patient.—The patient should remain in bed at least twelve hours before the operation, and during that time the vagina should be well douched with an antiseptic solution on at least two occasions. The pubic hair in the immediate neighbourhood of the vaginal orifice should be cut. The bowels should be opened by an aperient, such as castor-oil, on the evening of the day preceding the operation, and next morning a soap and water enema should be given at least three hours before the operation.

When the patient is anaesthetized and in position on the table the parts surrounding the vagina should be well douched, and the vulva and the skin adjacent to it should then be painted with 2 per cent iodine solution, and the cervix, when pulled down, should be similarly treated.

Instruments required.—There are two main types of instrument for dilatation of the cervix—graduated dilators and the three-bladed screw dilator. Graduated dilators are in my opinion much more efficient and safer. Of the various patterns, that of Fenton is the best. The surgeon should see that the instrument-maker has not fashioned the dilators too blunt at the point : in the original and proper design they taper somewhat. These dilators are double-ended, and the extreme size to be used in any particular case depends upon the nature of the operation. Thus for dysmenorrhoea or sterility dilatation up to No. 10 is sufficient; for curettage Nos. 12 to 14; for digital exploration Nos. 18 to 20; and for evacuation of early pregnancy Nos. 26 to 30. Besides the dilators the following are also required: Auvard's self-retaining speculum; two volsella forceps; a uterine sound; a pair of scissors; a roll of sterilized narrow white gauze for plugging the uterus, if necessary; a roll of broader white gauze for packing the vagina. It will be well also if the surgeon carries with him a few additional instruments in case he should need them, such as a pair of ring forceps, a few pairs of Spencer Wells' forceps, and some needles and ligature material.

The Operation.—The patient having been fixed in the lithotomy position and the parts prepared as described in another place,[1] the surgeon should begin by making a thorough bi-manual examination to ascertain the lie and dimensions of the uterus, and the condition of the tubes and ovaries, and to exclude the presence of any condition which would contra-indicate the operation. The speculum should now be introduced and the cervix pulled down with the volsella forceps. It is better to use a pair of these, one on either cervical lip or both on the anterior lip, so as to secure a firmer hold. The sound should then be passed to gauge the length and direction of the uterus (Fig. 268). The dilators are now to be pushed in one after the other; the operator keeping in mind the direction and length of the cavity as previously ascertained. Great force must not be used, and if difficulty is experienced as the dilatation proceeds the operator should retrace his steps and re-pass one of smaller size, and so work up gradually to the point where much obstruction is encountered. As a safeguard against perforating the uterus the surgeon should either keep the fingers of his right hand extended so that in case of the instrument suddenly rushing on, their tips will impinge on the buttock before it can go very far, or he can use both hands, the one to push with and the other to act as a brake in case of necessity (Fig. 269).

The dilatation having been carried far enough the further course of the surgeon depends upon whether any other measure is required or not (see above). In the latter case the vagina should once more be douched out, mopped dry, and then plugged with gauze.

After-Treatment.—The gauze should be removed in twenty-four hours and the vagina douched three times a day with a weak antiseptic solution. The bowels should be opened on the second day and the patient should be kept in bed for a week.

Difficulties and Dangers.—The operation may be very difficult or even on occasion impossible where the cervix is very small, the canal very narrow, and the tissues very rigid.

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[1] See Article on Technique (pp. 283-368).

Splitting of the Cervix and Haemorrhage.—More or less splitting of the cervix in the neighbourhood of the internal os is a common event, but the rift is not deep as a rule; occasionally, however, it may go right through into the broad ligaments, severing some of the branches of the uterine artery, or even the main trunk. In this event severe haemorrhage instantly follows.

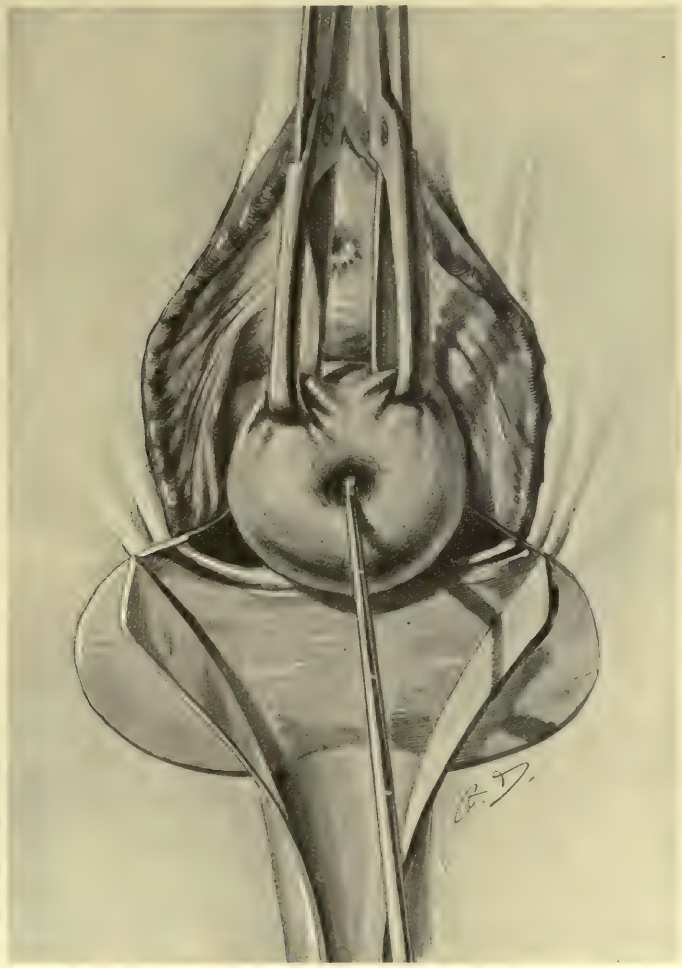

Fig. 268.—Dilatation of the cervix: passing the sound.

Undue bleeding after dilatation of the cervix can usually be checked by packing the uterine and cervical cavities with gauze and then firmly tamponing the vagina.

If one of the larger branches of the uterine artery or the main trunk be torn this will not suffice. In such an event an attempt may be made to compress the vessel by first pulling down the cervix as much as possible and then applying a long-bladed forceps, fenestrated for choice, so that one blade lies in the cervical canal and the other on the outside of the cervix reaching well up into the vaginal vault. If this manœuvre succeeds the forcep must be left on for at least twenty-four hours. If it fails to stop the flow of blood, or if there is reason to believe that bleeding is going on into the broad ligament the surgeon must proceed to expose the bleeding vessel. This can be done either from the vagina or from the abdomen.

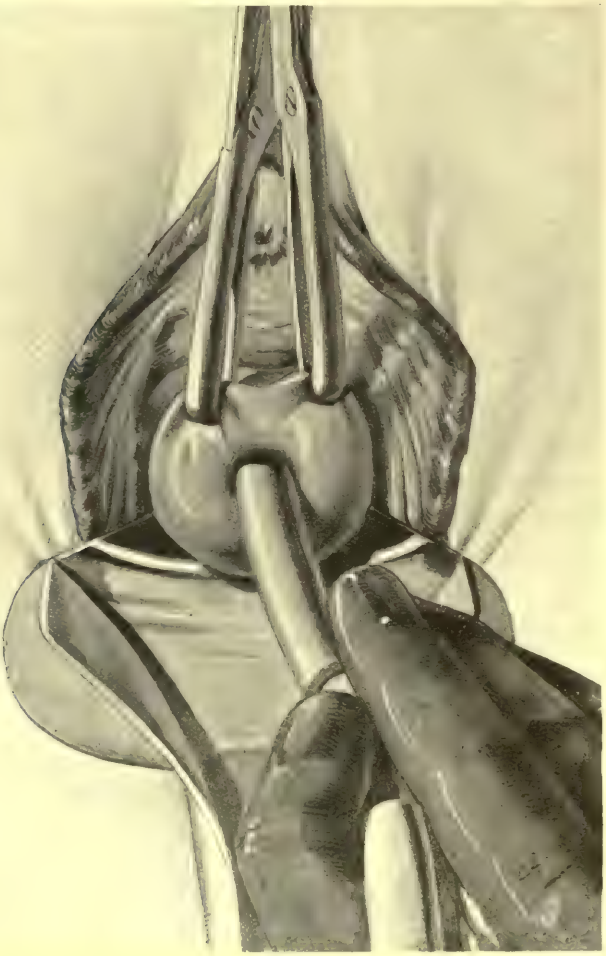

FIG. 269.—Dilatation of the cervix: passing the dilators.

If the vaginal route be chosen the steps adopted are similar to those with which a vaginal hysterectomy begins. The mucous membrane at the base of the vaginal cervix in front must be incised and the bladder separated and pushed back. The incision should then be continued round the base of the cervix on the side of the bleeding vessel, and the uterine artery sought for, as it leaves the broad ligament to enter the uterus.

When found it must be ligatured or clamped. It is most important for the surgeon to be sure that the ureter is not included in the grip of the ligature or forceps. This danger is a very real one, and for that reason the writer would much prefer the abdominal route in the emergency under discussion.

The steps of this proceeding are similar to those which precede the removal of the whole uterus through an abdominal incision, that is to say the ovarian and round ligaments having been divided the layers of the broad ligament are separated and the uterine artery is sought for and secured just before it enters the uterine wall. In some instances it might be possible to avoid dividing the upper part of the broad ligament, but as a rule this will be necessary to get a good view, for a large haematoma has usually formed in the parametric tissue.

The accident is, however, largely to be avoided by gentleness and by keeping the direction and length of the cavity, as previously ascertained by the sound, constantly in mind.

Perforation of the Uterus.—Sharp flexion of the uterus, especially anteflexion, may interfere with the passage of the dilators by their points impinging on the cervical or uterine wall, and in such cases perforation is liable to occur at the point of flexion. The clumsy exercise of force may of course result in a dilator being thrust through the fundus.

It is, however, important to realize that under conditions of abnormal softness or fragility of the uterine wall perforation may take place even when the greatest care and gentleness are used. Thus the senile uterus is easily perforated, as is the small organ due to congenital lack of development, while corporeal carcinoma may so soften the uterine wall that the dilator passes through it without any sense of encountered resistance. If the accident be unrecognized and an intra-uterine douche be given much of it flows into the peritoneal cavity. In such a disaster the abdomen should be at once opened, the solution mopped out, the uterus removed or stitched up as appears advisable, and vaginal drainage established; a drain had better also be inserted through the abdominal wound.

Generally speaking, in the event of perforation of the uterus the course to be followed depends on the circumstances. If the case is neither septic nor one of malignant disease, no harm results as a rule, and in such nothing further should be done beyond keeping a close watch on the patient in case signs of internal haemorrhage or peritonitis manifest themselves.

If the uterus be septic or the seat of a malignant growth the abdomen should be opened as soon as possible, and the uterus removed to minimize the peritoneal dissemination of organisms or cancer cells.

The most serious cases are those in which the surgeon, ignorant that he has perforated the uterus, flushes out the organ with mercurial solution or some other strong antiseptic.

Sepsis.—Sepsis may occur after operative dilatation of the cervix as after any other operation. It usually takes the form of a broad-ligament cellulitis the infection having spread from a laceration of the cervix. This is a rare occurrence, except in those cases in which the uterus is already septic, and must be treated like any other case of cellulitis in that situation.

Salpingitis may follow dilatation of the cervix either by reason of want of surgical asepsis or from the unavoidable transplantation of vaginal organisms into the cavity of the uterus. This latter is liable to occur if the cervix is dilated while the vagina is inflamed, especially when the inflammation is due to the gonococcus, and therefore no such proceeding should be entertained, except of necessity, in cases in which the lower passage is alone deemed to be infected. Septicaemia is a very rare event. When it occurs the entrance of the organisms into the blood stream is probably effected through a cervical laceration.

CURETTAGE OF THE UTERUS

Indications.—Curettage is usually carried out as a means of curing those diseased conditions of the endometrium which collectively come under the head of "Endometritis." It is also performed to remove retained products of gestation in certain cases. Finally, it may be employed to remove a portion of the endometrium for diagnostic purposes, as in the case of suspected carcinoma of the body of the uterus.

Instruments required.—Those for dilatation of the cervix and in addition a flushing curette, a sharp spoon, and a pair of ring forceps.

The Operation.—In most cases the cervix has first to be dilated, and this part of the operation is to be carried out as described on page 676. This should be accomplished up to size Nos. 12 to 14 (Fenton), unless it is desired to introduce the finger beforehand, when size No. 18 must be attained.

Digital exploration of the uterus is necessary for the removal of a large mass of gestational products, and is also desirable when the operation is being performed to ascertain or exclude the presence of malignant or other growth in the cavity of the uterus. It is not, however, always possible to achieve this amount of dilatation when the cervix is very small and tight, as is the case with some elderly women: in such digital exploration has to be dispensed with. The curette should be introduced to the top of the uterus and then drawn downward pressed against the uterine wall like a rasp (Fig. 270). This movement should be methodically repeated until every part of the wall has been scraped. The strips of endometrium removed should be collected and examined. If a flushing curette is used, it is important not to turn on the flush until, by careful sounding with the end of the instrument, it is certain that no perforation of the uterus is present. Care should also be taken to avoid scraping over any laceration of the cervix previously produced by the dilatation of the cervix; for if

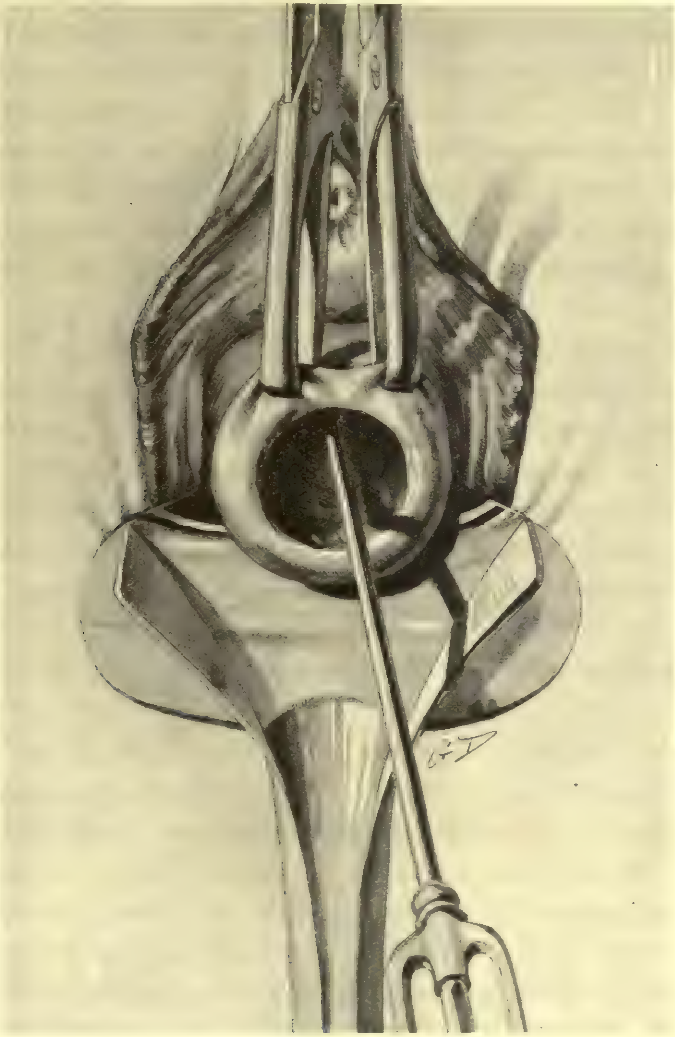

Fig. 270.—Curetting the uterus.

this is done the tear may be extended right through it. The erasion having been thoroughly effected, the uterine cavity must be well washed out with an antiseptic solution, such as biniodide of mercury, 1 in 1000, and the vagina packed with sterile gauze.

When curettage is being employed for the cure of some infective condition of the endometrium a useful addendum to the operation is the application to the uterine wall of powerful antiseptic escharotics, such as pure carbolic acid, iodized phenol (iodine 1 part, carbolic acid 3 parts), chloride of zinc (gr. xxx ad ℥i), or nitric acid. The object of such application is to destroy organisms sequestered in the depths of the uterine and cervical glands, the ablation of which with a curette is impossible owing to the depth to which they extend into the uterine musculature. For ordinary use for this purpose pure carbolic acid or iodized phenol is the best.

Nitric acid should only be employed for those troublesome cases of chronic infective (usually gonococcal) endometritis in which the usual measures have been repeatedly tried and failed. It requires very careful management lest the scarring after the extensive tissue destruction result in occlusion of the cervical canal. The acid should be introduced on a swab through a glass tube fixed in the cervix, and should be immediately washed out again with a strongly alkaline solution. It is questionable if this treatment is ever to be recommended. Such intractable discharge is best cured by hysterectomy.

The routine application of a strong antiseptic to the uterus after curettage is unnecessary.

Difficulties and Dangers.—These are chiefly the same as already discussed under the heading of dilatation of the cervix. Perforation of the uterus by the curette is less likely than passing the curette through an aperture already made by a dilator. Violent results follow passage into the peritoneal cavity of certain antiseptic solutions, notably those of the mercurial salts, and hence the flush should never be turned on until it is certain there is no hole in the uterus. Sepsis may follow curettage and may assume the form of cellulitis, salpingitis, or even septicaemia, the former being the commonest type. Free haemorrhage after curettage can be controlled by plugging the uterus, and under it the vagina, with sterile gauze.

After-Treatment.—The patient should be kept in bed for a week to ten days, and in any event always until the blood loss that follows the operation has completely stopped. If the uterus is large ergot is usefully administered during convalescence.

REMOVAL OF RETAINED PRODUCTS OF CONCEPTION

Indications.—Retained products of conception require removal on account of either haemorrhage or sepsis.

Preparation of the Patient.—As for dilatation of the cervix (see p. 676). As many of these cases are urgent it is often not possible to carry out the routine there described.

Instruments required.—Those for curettage (see p. 680), and in addition two pairs of ovum or ring forceps.

The Operation.—The patient being placed in the lithotomy position, the position and size of the uterus are defined bi-manually. Auvard's speculum is now introduced and the vagina thoroughly washed out. The cervix is then seized and pulled down. If it is soft, this is best effected with ring forceps as volsellae tend to lacerate and cut out. The cervical canal has now to be dilated, though in some cases it is possible at once to pass the finger through it into the uterus. If instrumental dilatation is necessary, this must be carried up to No. 18 to 20 (Fenton). The index finger is now passed into the uterus, but before this is done, it is better to remove Auvard's speculum and, if necessary, the forceps attached to the cervix, because these instruments get in the way. The other hand is then placed on the abdomen, and the fundus of the uterus is pressed down on to the finger in the uterine cavity (Fig. 271).

This manœuvre is absolutely necessary for otherwise the longest finger is unable to reach sufficiently high properly to explore the cavity. The position of the retained tissue having been defined, the finger in the cavity is now used to break it up and detach it from the uterine wall. This must be thoroughly done.

The finger is now withdrawn, the speculum re-inserted, and the cervix seized anew and drawn down. A ring forceps is then repeatedly introduced, and the detached fragments are removed by its means piece by piece until no more can be grasped by it (Fig. 272).

The finger is now again inserted in the manner already described, to see if the cavity is empty and no parts of the gestation-products are remaining attached to the wall. If such pieces are felt, the procedure already described must be repeated until it is certain nothing remains behind. The flushing curette is now lightly employed, both to remove small fragments not already detached and to wash out the uterus. This accomplished, the vagina should be plugged with gauze. If there is undue bleeding from the uterus, the uterine cavity must also be plugged, but such a necessity often implies that all the fragments have not been removed. A hypodermic injection of ergotin is usefully given where the uterus is flabby or inert.

Difficulties and Dangers.—If the uterus is retroverted, it will require anteverting before the hand on the abdomen can press it down on to the introduced finger. Complaint is sometimes made that the finger cannot be made to reach to the fundus. In most cases this is solely because the technique described is not carried out.

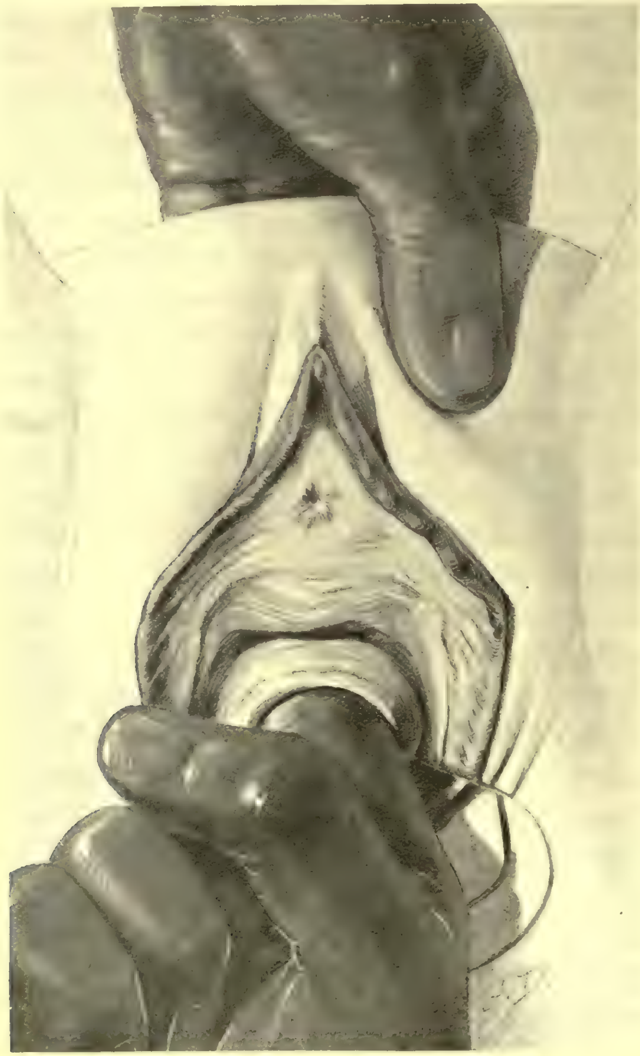

FIG. 271.—Digital exploration of the uterus.

Occasionally, however, the uterine cavity is so large that the utmost effort of the hand on the abdomen cannot press it down sufficiently. In such a case the ring forceps must be introduced, and portions of the retained tissue successively removed. As this is effected the uterus contracts down until it is finally possible to feel its entire inner surface.

Bleeding.—Haemorrhage is often free but nearly always greatly diminishes after the uterus is emptied. It can in any event always be controlled by packing.

Perforation of the Uterus.—Perforation of the uterus either by the dilators, the finger, or the curette is a possibility always to be borne in mind. In this connection it may be emphasized that it is unnecessary to pass the dilators much above the internal os, for it is the cervix alone that needs enlarging. If a practice is made of exploring the whole cavity with the finger, this accident cannot go undetected. Cases have occurred in which the practitioner cut or tore away omentum or bowel that had prolapsed through a rent. Such a disaster is to be guarded against not only by taking the precautions mentioned, but also by handling with circumspection any

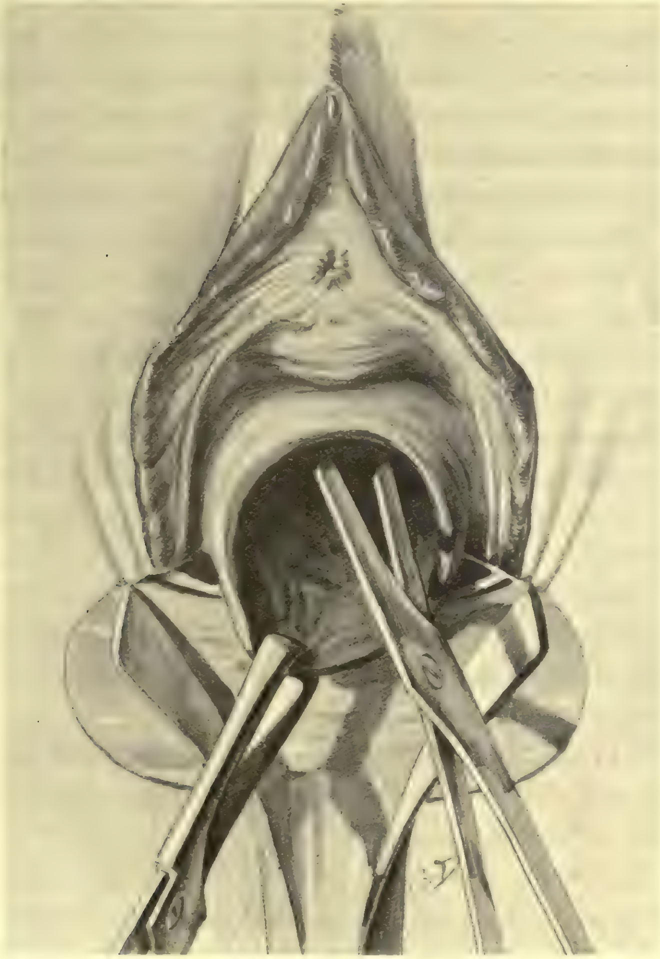

Fig. 272.—Removing retained products of gestation by means of ovum forceps.

substance found in the cavity whose character does not seem to accord with any possible products of gestation.

Prolapse of Intestine or Omentum.—There is but one course to pursue in the event of bowel or omentum appearing in the uterus, namely immediately to open the abdomen. This is a rule to which there should be no exception, tempting as it may appear merely to push back the prolapsed mass and plug the uterus with gauze. For in addition to the certainty that so large a rent in the uterine wall will occasion bleeding into the peritoneal cavity, the bowel or omentum is always more or less damaged. This particularly applies to the prolapsed segment of bowel which, on opening the abdomen, is nearly always found to have been detached from its mesentery. The surgeon having explored the extent of the damage must proceed to deal with it. The perforation in the uterine wall may be closed with sutures if not too extensive, and the bleeding from it can in this way be satisfactorily controlled, and above all if the uterine cavity is known to be aseptic. In default of these desiderata the uterus must be removed either in whole or part.

As the accident under discussion usually occurs in the course of emptying the uterus of infected gestation-products the removal of the whole uterus will most often be called for, the vagina being left open to establish drainage of the pelvic cavity. When the hysterectomy is being performed solely to arrest bleeding the ‘ subtotal ’ operation is preferable.

As regards the treatment of the bowel that has prolapsed, resection of the damaged portion will usually be needed, with subsequent end-to-end anastomosis. It is the small intestine that has passed through the rent as a rule. Bruised or lacerated omentum should be ligatured and removed.

The prognosis in these cases depends upon the rapidity with which the accident is recognized and the abdomen opened, the extent of the injury to the bowel, and the asepticity or otherwise of the uterine cavity.

Cases dealt with boldly and at once usually recover, but the mortality is heavy if the gravity of the accident, or even the accident itself, is overlooked until symptoms of peritonitis begin to manifest themselves.

TRACHELORRHAPHY

Indications.—Repair of a laceration of the cervix is indicated when the inner surface of the lips that result from the laceration are the seat of chronic cervicitis and ‘ erosion.’ The mere presence of a labiate condition of the cervix is not an indication as long as the lips are neither hypertrophied nor inflamed. The operation of trachelorrhaphy is a defective one in that it utilizes part of the eroded surface to form the restored cervical canal, and if hypertrophy of the lips is present it results in the formation of an abnormally long cervix.

Instruments required.—Auvard's speculum, a pair of volsella forceps, dissecting forceps, two pairs of Spencer Wells' forceps, scissors, curved needles, bichromate catgut No. 2, and a scalpel.

The Operation.[1]—The patient is placed in the lithotomy position. Auvard's speculum is introduced and the cervix pulled down and painted with iodine. A volsellum is now fixed to each lip and the laceration or lacerations (depending on whether the tear was unilateral or bilateral) are opened out to their widest extent. The receding angle of the laceration is now incised so as to deepen the laceration and open it out still further. Four areas are now delineated with the edge of the scalpel, one on either side of each lip.

The tissue covering these areas is next dissected off so that a central strip of mucous membrane is left on the inner side of each lip to form the restored canal. The two lips are now sutured together, the sutures being passed deeply and under the whole breadth of the freshened surfaces. When the sutures are tied the vaginal cervix will be reconstituted. The vagina should then be well douched out and the cervix painted with iodine solution. The vagina should then be plugged with gauze sufficiently to restrain any oozing.

After-Treatment.—The gauze packing should be removed in twenty-four hours, after which the vagina must be douched with an antiseptic solution three times a day till all discharge has ceased. The patient will require to be kept in bed for ten days.

Difficulties and Dangers.—If the cervix is small and high up a difficulty may be experienced in seeing the parts, in dissecting the areas, and in passing the sutures.

The cervical tissue is often very tough as the result of chronic cervicitis, and the needles used should be stout or they may break.

AMPUTATION OF THE CERVIX

Indications.—The cervix may require amputating on account of hypertrophy, cervicitis, and erosion, or because it is the site of a new growth, such as a myoma or a cyst. A distinction is sometimes made between amputation of the vaginal cervix and amputation of the whole cervix, but this is not of practical value, the technique being the same, no matter how much or how little is removed. It is most often called for on account of hypertrophy of the cervix combined with prolapse of the vaginal vault. It is also the surest method of curing leucorrhoeal discharge when this arises as the result of chronic cervicitis and erosion. It is an operation of much superiority to trachelorrhaphy, especially in this last respect.

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[1] The technique of trachelorrhaphy has been also discussed in the Article on Lacerations of the Cervix (Vol. II. pp. 169-189).—EDITORS.

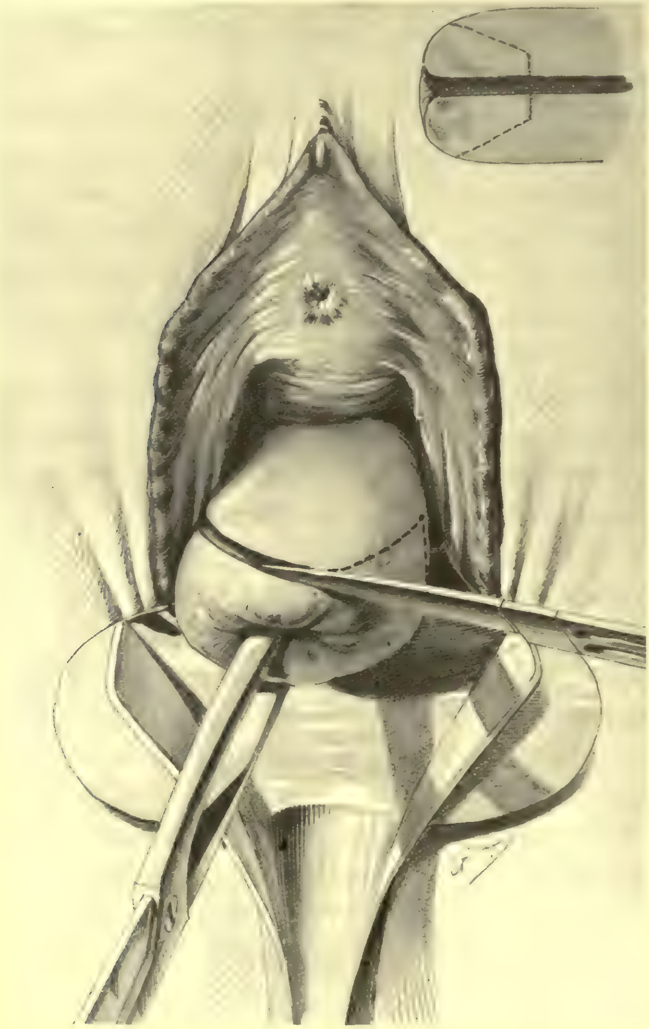

FIG. 273.—The author's operation for amputation of the cervix. Cutting the anterior flap.

The technique to be described is that originated by the writer. It greatly simplifies the operation, especially in cases in which the cervix is difficult of access. It is applicable to all degrees of amputation, from removal of the whole cervix to the superficial excision of an erosion, and it effects certain, firm, and lasting co-aptation of the mucous membrane of the cervical canal to that covering the vaginal aspect of the cervix.

Instruments required.—Those for trachelorrhaphy. In addition, a strong-handled needle is advantageously included.

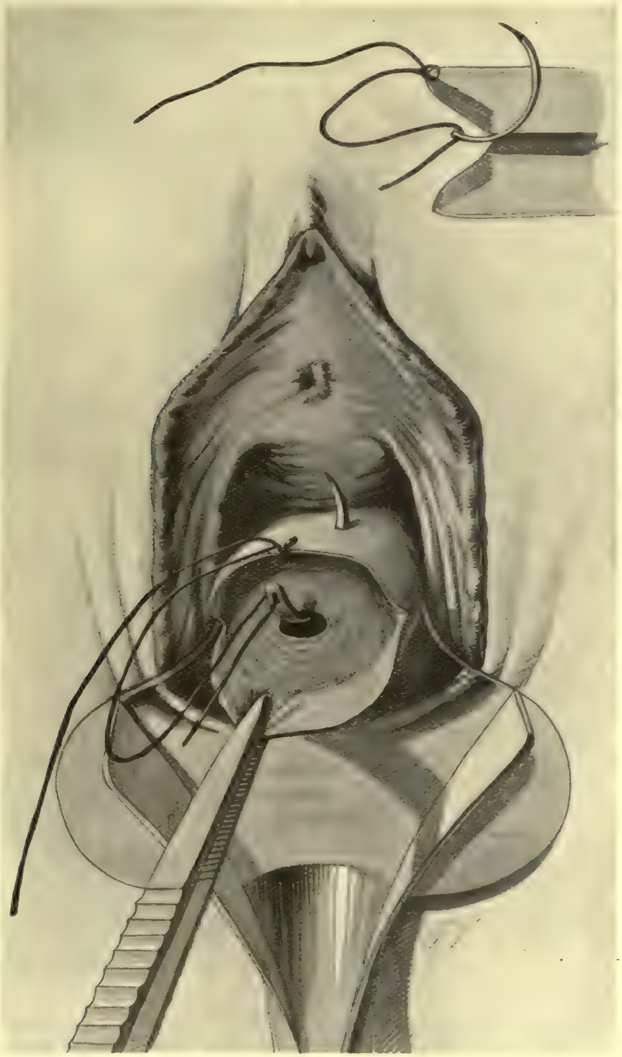

FIG. 274.—The author's operation for amputation of the cervix.
Passing the first end of the anterior approximating suture through the cervical stump.

The Author's Operation.—The patient is placed in the lithotomy position. Auvard's speculum is inserted and the cervix is pulled down.

A degree of preliminary dilatation of the cervical canal aids the surgeon in identifying it on the face of the stump, and makes it easier to pass the needle into it when inserting the 'approximating' sutures. It is therefore advisable to precede the amputation by passing dilators up to about No. 8 (Fenton) in all cases.

Curettage of the uterus as well as amputation of the cervix is often necessary, and if this is the case the dilatation of the cervix must be carried often up to about No. 12 to 14 (Fenton).

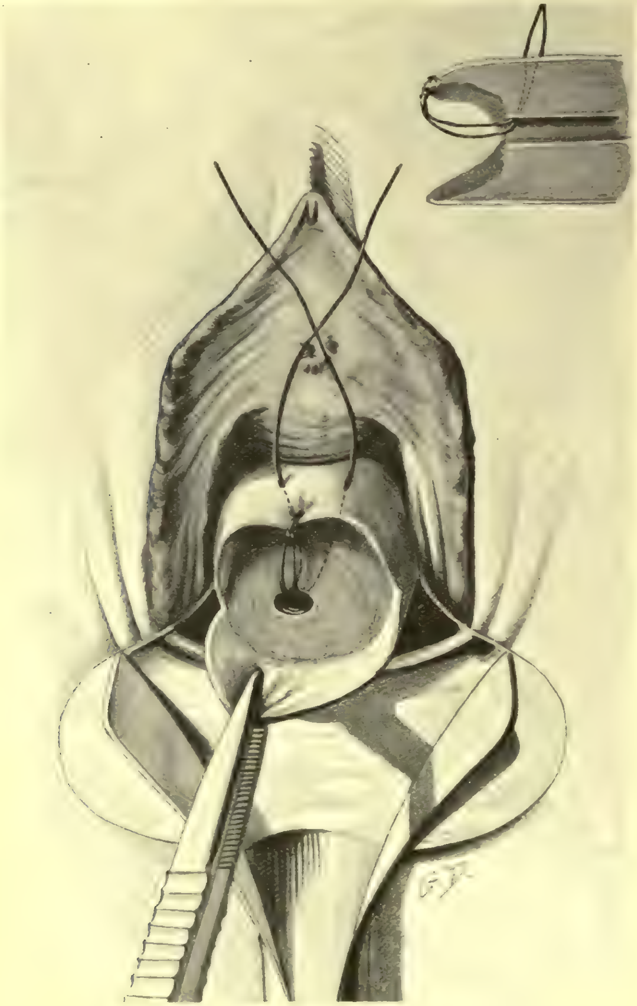

Fig. 275.—The author's operation for amputation of the cervix. Both ends of the anterior approximating suture are now passed.

With the scalpel a flap of mucous membrane is delineated on the anterior aspect of the cervix and dissected back. At its base a certain amount of cervical tissue is included in it (Fig. 273).

A similar flap is now dissected up on the posterior aspect of the cervix. The cervix is now amputated by cutting it straight across at the level of the bases of the flaps. The bleeding is free from the face of the stump, but, unless an exceptionally large vessel is spouting, ligatures are unnecessary, for the arrest of haemorrhage is complete when the sutures now to be described are tied.

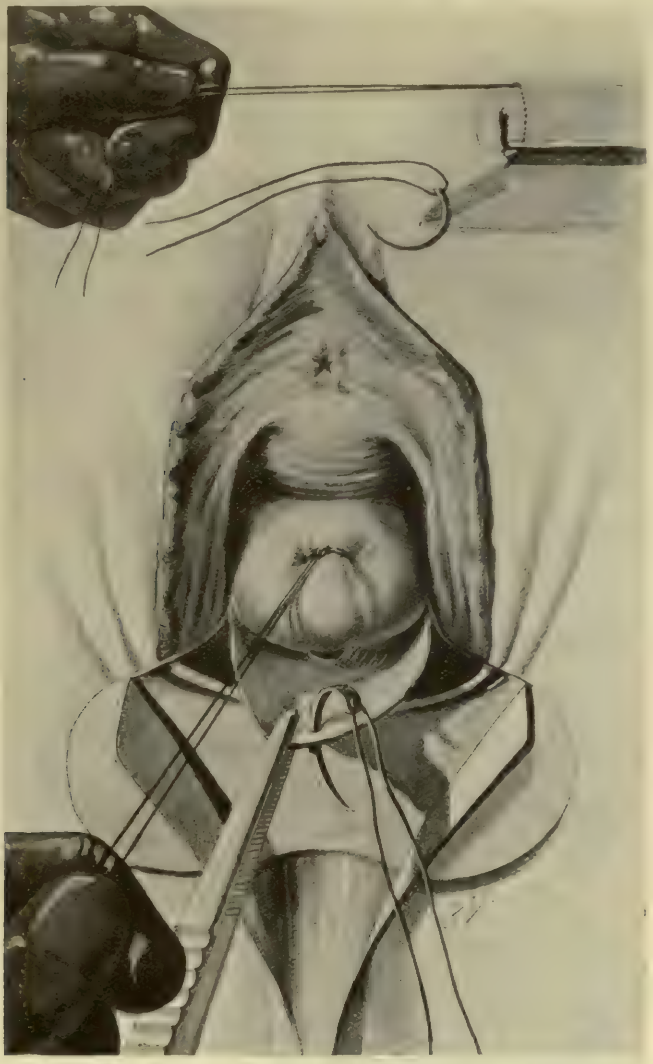

FIG. 276.—The author's operation for amputation of the cervix.
The anterior approximating suture tied. First step in the introduction of the posterior approximating suture.

The method of inserting these sutures is as follows : a long ligature is passed by a needle through the apex of the anterior flap and tied there, leaving both ends long with the needle attached to one end.

The needle is now entered through the cervical canal and made to protrude at the base of the anterior flap, and passing right through the thickness of the cervical stump so that when the needle is withdrawn the end of the suture follows after it (Fig. 274).

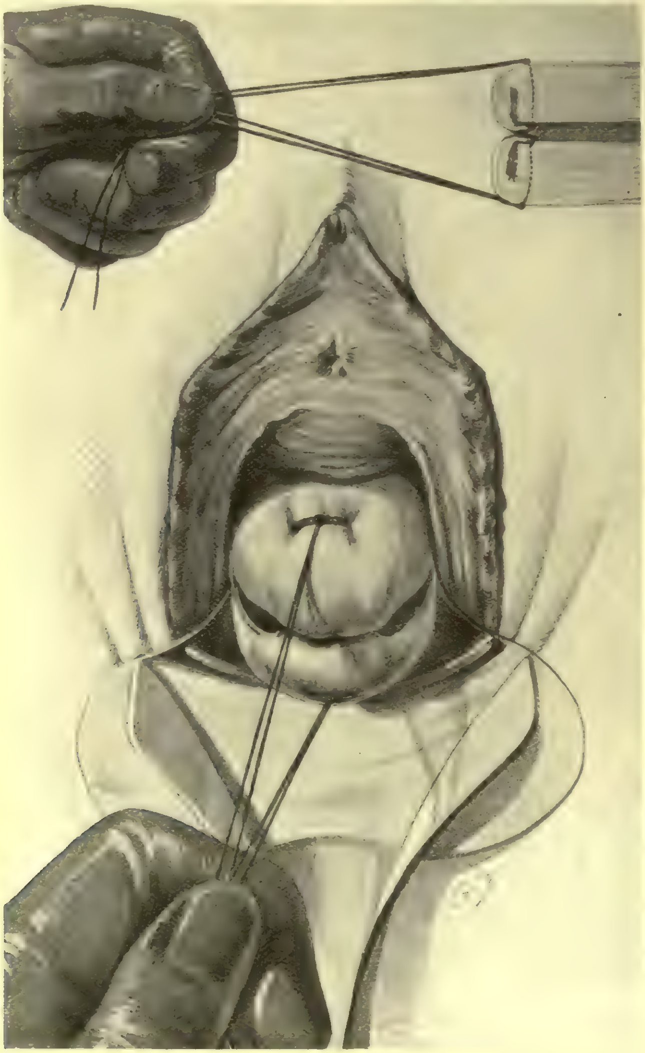

Fig. 277.—The author's operation for amputation of the cervix. Anterior and posterior approximating sutures both tied.

If the suture is now pulled upon it will be found that the flap is rolled over so that its apex is brought into apposition with the mucous membrane lining the cervical canal.

Using this long end of the suture as a tractor to pull down the cervix the needle, being threaded on to the other long end, is again entered through the cervical canal, slightly to one side of the first made track, and is again made to protrude through the base of the flap, after which it is again withdrawn (Fig. 275). The two long ends are now tied together, and the flap is permanently fixed in position in contact with the mucosa of the cervical canal (Fig. 276). The posterior flap is now similarly treated and rolled over to meet the mucosa of the cervical canal (Fig. 277).

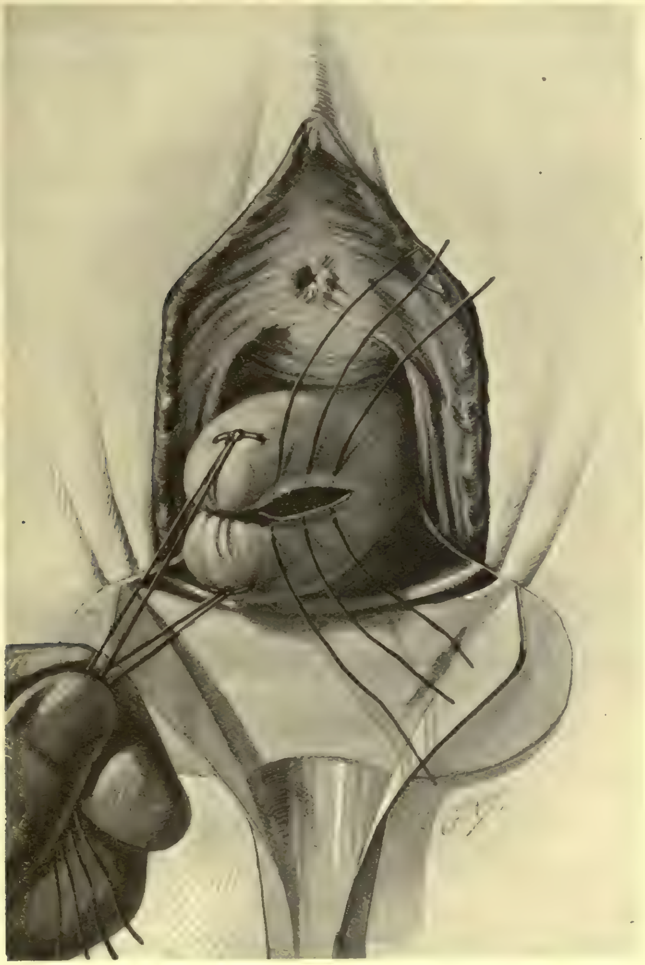

FIG. 278.—The author's operation for amputation of the cervix. The lateral sutures inserted.

The ends of these anterior and posterior 'approximating' sutures should be left uncut for they make an excellent tractor to bring the cervix down whilst the remaining sutures are inserted. These are passed from before backwards so as to close the lateral gaps that remain between the anterior and posterior flaps. These sutures should be passed deeply right through the tissue on the cervical stump so as to assist in stopping the bleeding from it (Fig. 278).

The vagina is now to be firmly packed with gauze and the operation is concluded.

Difficulties and Dangers.—Amputation of the cervix is a difficult operation where the vagina is narrow and the cervix high up. The bleeding is always free and can only be efficiently controlled by the pressure of the sutures. For this reason it is desirable to get them inserted and tied as soon as possible. The technique described, which I originated some years ago, greatly simplifies the operation. It is most necessary that the needle employed be very strong, for the cervical tissue is often extremely tough, so that the risk of breaking the needle is considerable if it be weakly made. A special cervix needle (author's pattern) will be found very efficient, though at first sight it might appear unnecessarily heavy and clumsy. If this needle is used it is best to begin the insertion of the approximating sutures by passing them through the thickness of the cervical stump before attaching them to the apex of the flaps.

The risks of the operation are haemorrhage, sepsis, and injury to the bladder or bowel. The first two ought to be abrogated if the operation and operative technique are correctly carried out. The catgut used should be *chromicized*, for if the sutures are absorbed too soon secondary haemorrhage is liable to occur.

Injury to the bladder or even the bowel might happen, if in making the flaps the surgeon began them too near to the vaginal vault, or carried them too high up the cervix.

THE REMOVAL OF POLYPS

The method of removal of an innocent polyp depends on its site of origin and its size. Polyps may grow from either the corpus or the cervix. If corporeal they may be (1) contained in the uterus ; (2) presenting at the external os ; or (3) protruding into the vagina. Cervical polyps necessarily protrude into the vagina more or less.

Corporeal Polyps contained in the Uterus.—Obviously the presence of a polyp in the corpus uteri can be known only when the cervical canal is large enough to pass the finger through it.

If then the presence of the polyp be suspected and it be deemed proper to remove it by the vaginal route, the cervix must first be dilated to finger size, *i.e.* No. 18 (Fenton). The polyp being found, it may be removed by torsion, enucleation, morcellation, or vaginal hysterotomy.

(1) *Torsion.*—Torsion consists in seizing it with forceps and twisting it off. The most useful instrument for this work is a fenestrated forceps, such as is figured (Fig. 279). Little or no bleeding follows the removal. In all cases of mucous polypus curettage of the endometrium should complete the operation.

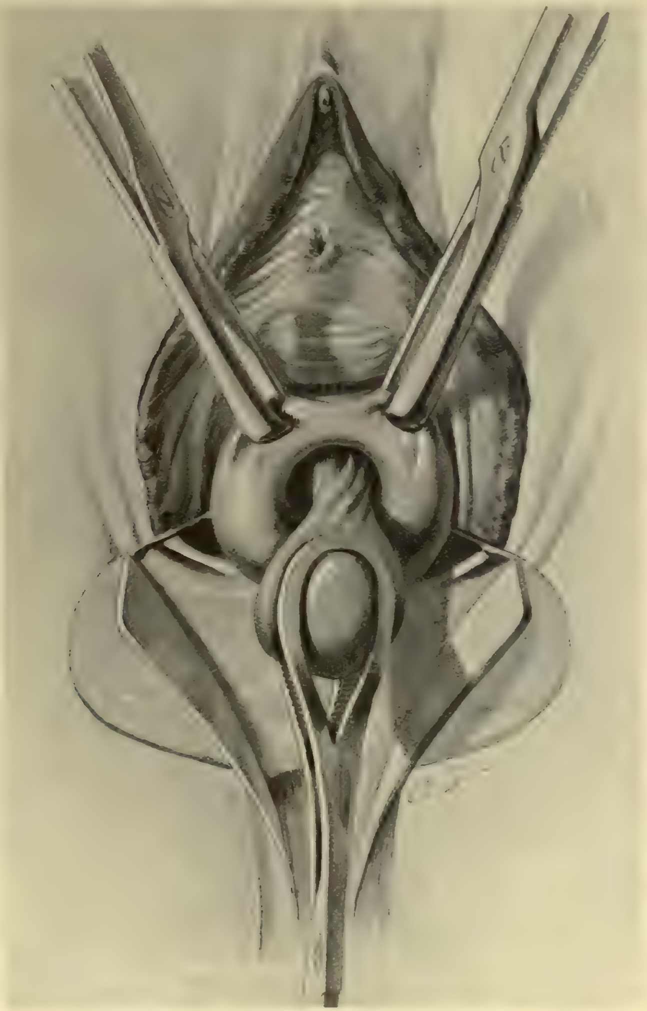

Fig. 279.—Removing a polyp by torsion.

(2) *Enucleation.*—If the peduncle of the polyp be too thick for torsion the surgeon may incise the capsule of the tumour if it be a myoma and enucleate it, afterwards cutting away the collapsed capsule and pedicle with scissors (Figs. 280 and 281).

(3) *Morcellation.*—Morcellation consists in cutting away piecemeal the mass to be removed. It is obviously an operation rarely indicated in cases of intra-uterine

polypi. It may be employed to remove polypoid myomata too large to ablate by evulsion, but as a rule such cases are best treated by abdominal hysterectomy or myomectomy.

The cervix, if not large enough, having been dilated sufficiently, the lower pole of the polyp is seized with volsellum forceps and the part being pulled down is then cut away (Fig. 282).

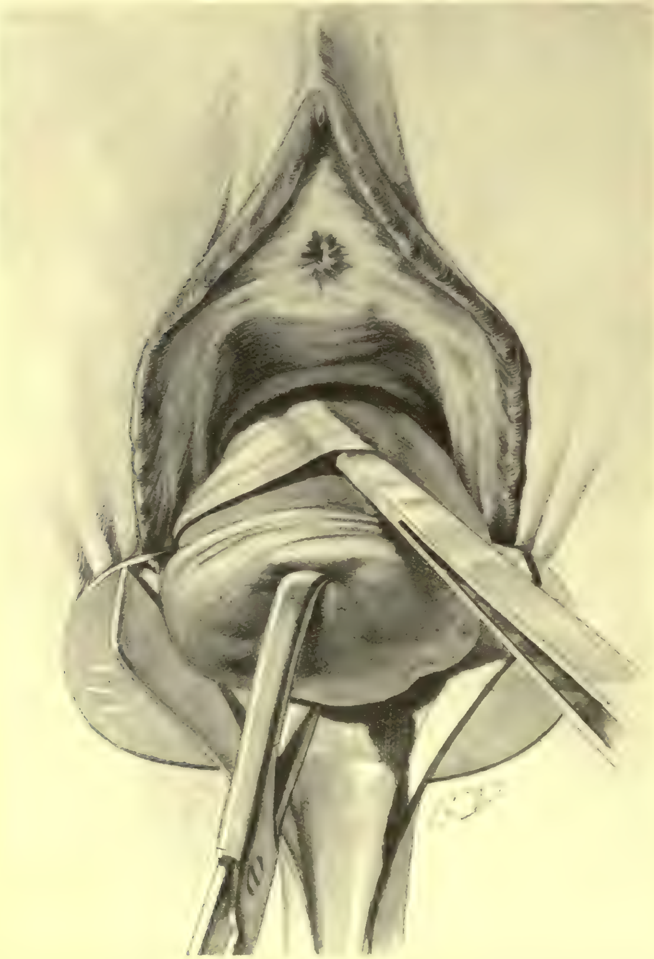

Fig. 280.—Removal of a fibroid polyp by first enucleating the fibroid : stripping the capsule.

The finger then seeks for the plane of cleavage between the fibroid and its capsule, and this being found, separates it as high as possible (Fig. 283).

The volsellum is then re-applied to a higher part of the mass, and the part brought down is cut away (Fig. 284).

The finger is once more inserted within the capsule, and the upper pole of the fibroid is separated and wrenched out with volsella forceps (Fig. 285). Finally the collapsed capsule is cut away with scissors (Fig. 286).

The operation is an unsatisfactory one, for as a rule it is impossible to differentiate between a sessile and a polypoid fibroid while still within the uterus.

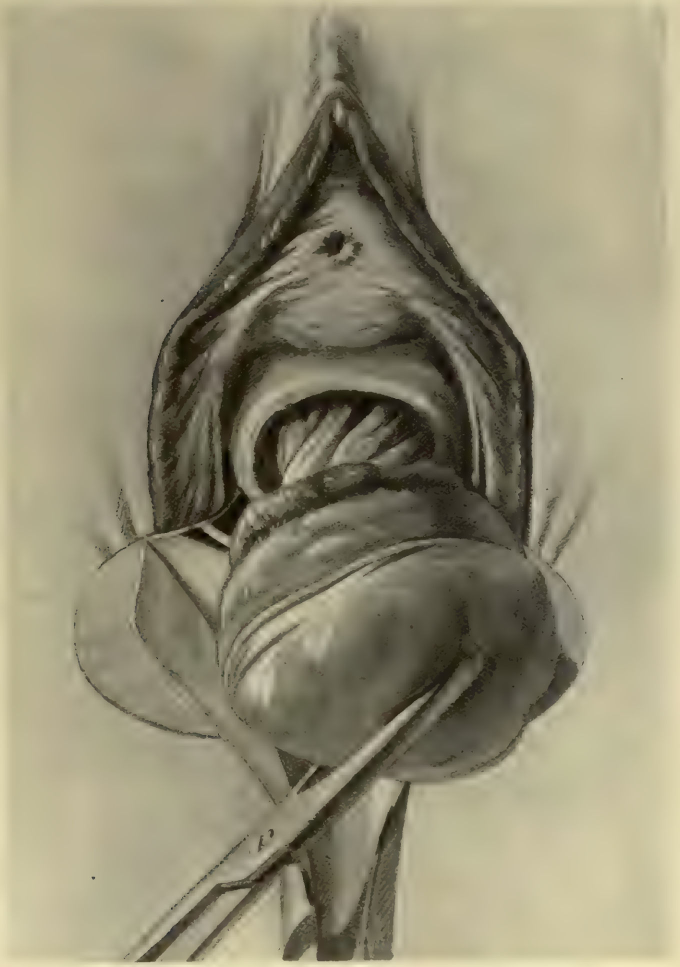

Fig. 281.—Twisting the fibroid out of its capsule.

(4) *Vaginal hysterotomy.*—Access to an intra-uterine polyp can be obtained by splitting the anterior wall of the cervix and lower uterine segment in the same manner as is carried out in vaginal Caesarean section (see p. 550). The steps of the operation are as follows:

A transverse incision is made across the front of the base of the cervix where it joins the anterior vaginal vault.

The bladder is exposed and is separated from the supravaginal cervix until the peritoneum of the utero-vesical pouch is reached. By means of a strong pair of scissors the anterior cervical wall is now divided in the middle line, and the incision is carried upwards through the front wall of the uterus until the anterior peritoneal reflexion is reached but not opened.

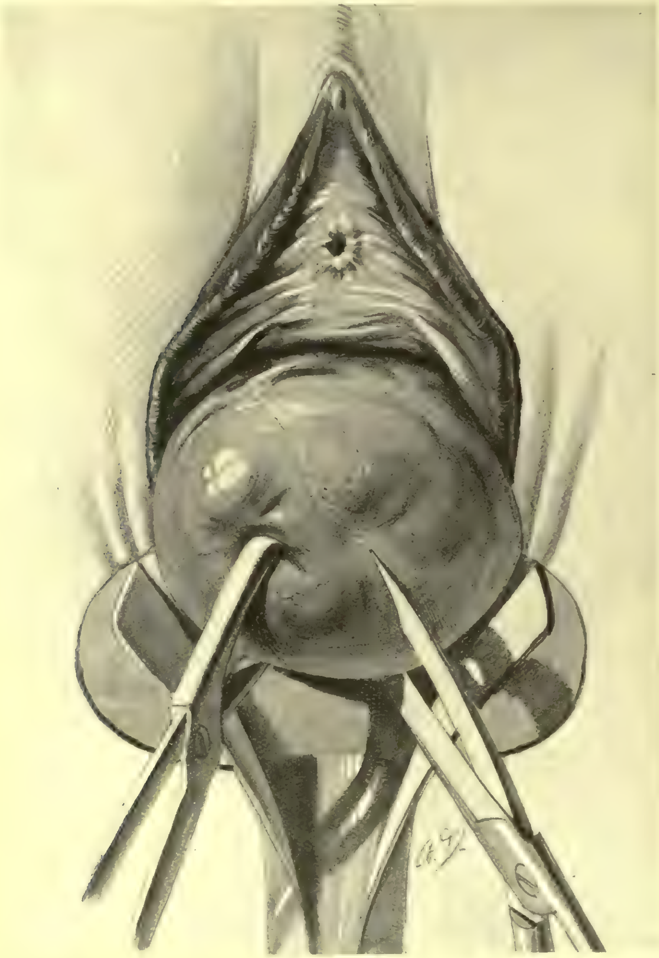

Fig. 282.—Cutting away the lower pole of a fibroid polyp large enough to fill the vagina.

Through the considerable aperture into the uterine cavity thus effected the fingers are then passed, and the situation, size, and nature of the intra-uterine tumour are defined. It can now be removed by evulsion, or if the pedicle be too stout for this the capsule, in the case of a myoma, may be incised and the tumour shelled out, the collapsed capsule and the pedicle being cut away with scissors afterwards. If this is not feasible owing to its size or because no defined capsule can be found, it may be cut away in pieces (morcellation). In either event the wound in the front of the uterus and cervix must be sewn up with catgut sutures after the uterus has been emptied. These should be deeply placed so as to control all oozing of blood.

Finally the incision in the anterior vaginal vault will require closure.

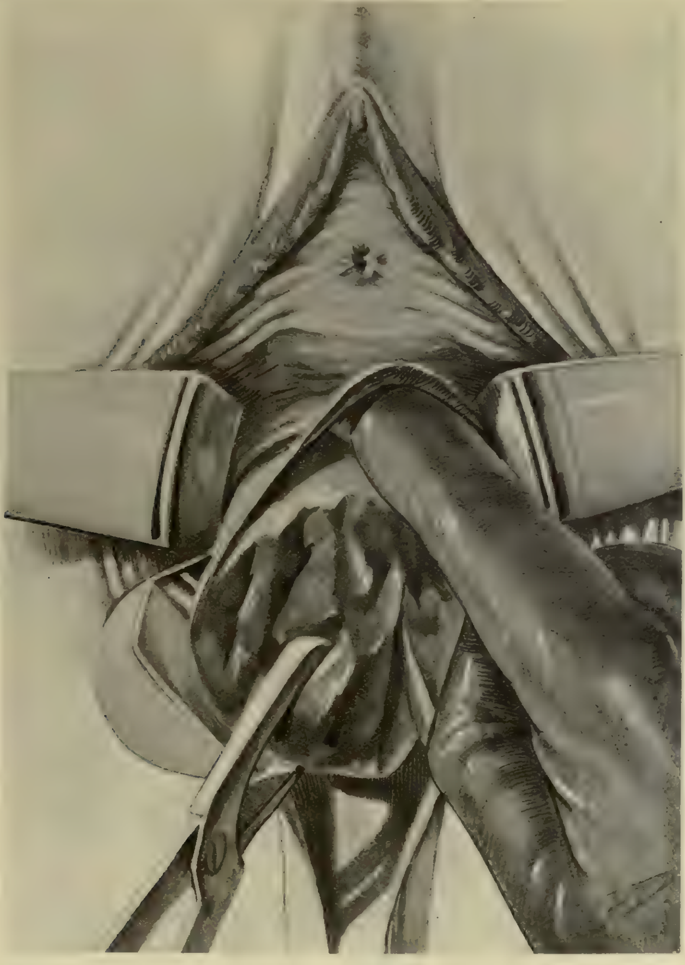

FIG. 283.—Separating the capsule after cutting away the lower pole.

Corporeal Polyps presenting at the Os.—The great difference in these cases from the foregoing is that preliminary dilatation of the cervix for exploratory purposes will be unnecessary, as the finger can be inserted straight away and the actual condition felt. This is a great advantage because the surgeon can thus be certain that the tumour either is or is not a polypus before he attacks it. If he determines to remove it from below he may employ any one of the methods already described.

Corporeal Polyps protruding from the Os.—In these cases the polypoid nature of the tumour is at once apparent, except in those rare cases in which the mass is so large that it entirely fills the vagina.

The removal of the polyp may be effected either by torsion, morcellation, or enucleation.

Torsion is carried out in the manner already described, but inasmuch as the pedicle extends up the cervical canal into the body of the uterus, it may be necessary to dilate the former in order to get the whole pedicle away.

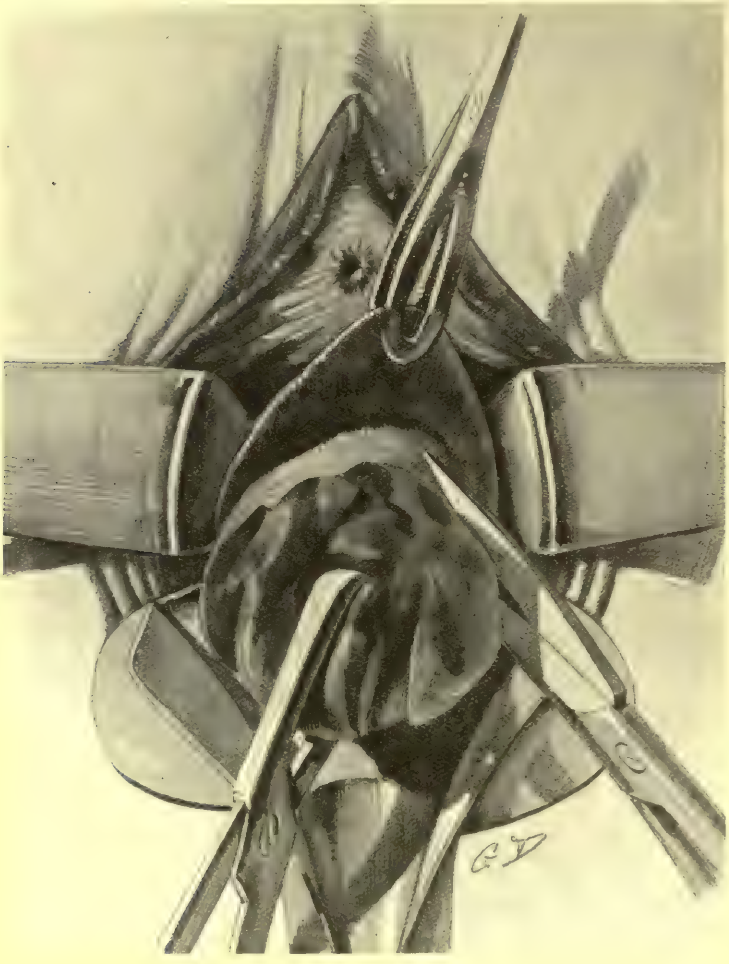

Fig. 284.—Cutting away a further portion of the fibroid.

Morcellation, which has been described, is easy in these cases because the tumour is so accessible. The bleeding is slight or if the mass is necrotic there may be none at all.

Enucleation, already referred to, is a method of dealing with myomatous polyps.

The capsule of the fibroid is split over its lower pole, the finger inserted between it and the myoma, and the latter is enucleated. The collapsed capsule and its attached pedicle is then torsioned or cut away with scissors at its base.

Cervical Polyps.—Innocent polyps growing from the cervix uteri are removable by torsion, morcellation, or enucleation. Inasmuch as the body of the uterus is not affected in these cases no curettage is required after removal of the polyp, neither is preliminary dilatation of the cervix needed to get at the pedicle. For the rest the operations are carried out precisely as already described when dealing with polyps springing from the corpus.

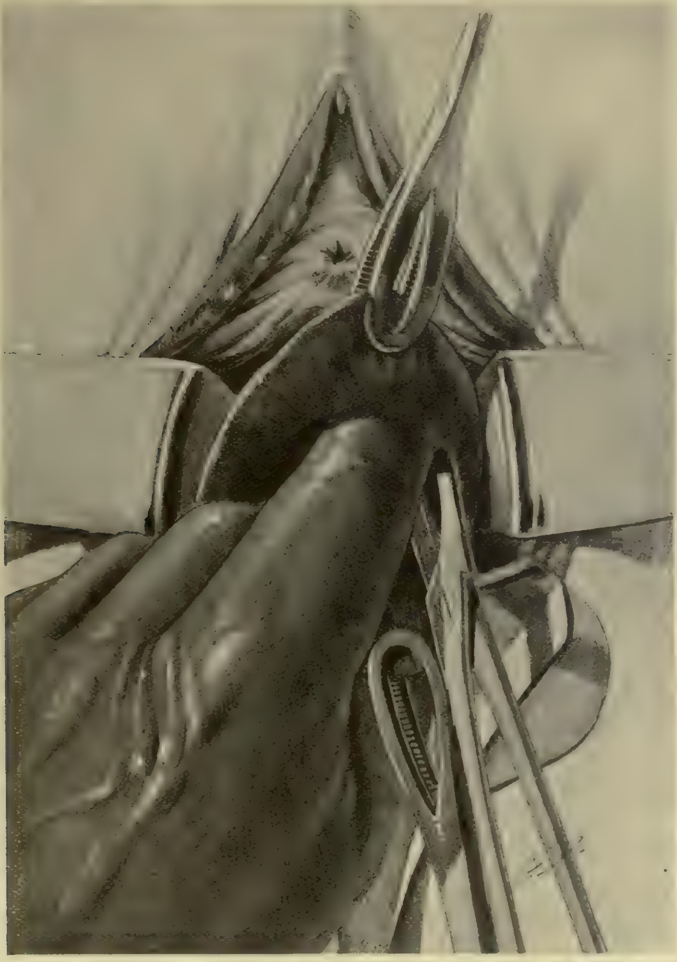

Fig. 285.—Separating the upper pole of the tumour.

Difficulties and Dangers.—*Intra-Uterine Polyps.*—The first difficulty is to be certain that the uterus does contain a polyp, for even if the lower pole of a tumour can be felt the mass may be a sessile one. The next difficulty is the restricted room in which the operator has to work in most cases. It is true that by vaginal hysterotomy this space may be considerably enlarged, but the latter proceeding may be a very difficult one, especially when by reason of the size of the tumour the uterus cannot be pulled down.

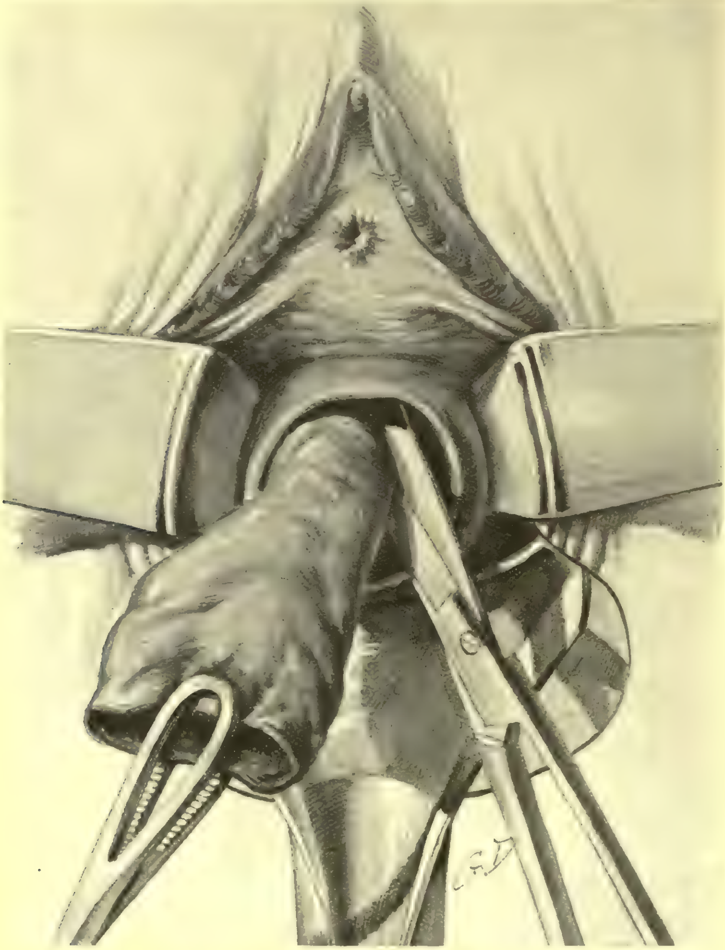

FIG. 286.—Cutting away the collapsed capsule.

Whilst therefore it is undeniable that very large intra-uterine tumours may be removed *per vaginam*, the writer believes that route is rarely to be preferred when the polyp is of considerable size, or when any doubt as to the polypoid nature of the tumour is present.

The operation of abdominal hysterotomy is simple and easy, and affords a much better view of the intra-uterine condition than any vaginal operation, and further, the abdominal route has this great advantage over the vaginal route that it is far more sterile and sterilizable.

Extensive vaginal operations should therefore be limited to those cases in which the abdominal route is undesirable. This chiefly obtains when the uterine contents are septic, as in a sloughing myoma.

The chief danger of the vaginal removal of an intra-uterine polyp is perforation of the uterus. This of course will not be present when the polyp is small and the pedicle narrow, but no hard-and-fast line can be drawn between pedunculated and sessile tumours, and in a large fibroid polyp the pedicle may be very thick. Moreover, the surgeon may very likely find that no pedicle exists, in which case he will have to resort to enucleation. In the case of an adenomyoma, however, no capsule is present, so that should the vaginal hysterotomist unluckily light upon one of these tumours it is certain that he will have to abandon his attempt to remove it in this way, and will be obliged to open the abdomen.

Polyps projecting into the Vagina.—The removal of a polyp projecting into the vagina is a very simple proceeding, evulsion by torsion being sufficient as a rule.

Morcellation and enucleation under like circumstances are not difficult, though in the first case the operation may take some time, as the mass to be removed will be very large. When, however, the polypus extends into the cavity of the uterus, as in the case of a large pedunculated myoma, its removal may be difficult. Such tumours indeed are often best dealt with by the abdominal route, especially if the uterus contains other tumours.

It is in cases of septic necrosis of such large fibroids that removal by the vaginal route is chiefly indicated, for in such cases an abdominal operation is fraught with danger of peritonitis.

Bleeding after the removal of a polyp is very rarely severe and can always be stopped by tightly plugging the vagina with gauze, and if necessary, the uterus itself.

The plugging should always be removed in twenty-four hours for fear of sepsis.

The Removal of Sessile Myomata by the Vaginal Route.—The methods of removing polypoid myomata by the vaginal route have already been described. In many cases of sessile myoma of the cervix, and in certain ones of sessile myoma bulging into the uterine cavity, the removal of the mass by the vaginal route is indicated. The operator's object is to enucleate the tumour from the capsule of uterine tissue that more or less surrounds it.

The capsule should be incised with a scalpel and the finger inserted between the tumour and its covering capsule, until the former has been completely detached, when it is pulled out by volsellum forceps previously attached to it. The proceeding is an easy one when the growth originates in the cervix.

With growths that are entirely intra-uterine, the proceeding is much more difficult because ingress is barred by the closed cervical canal. Preliminary dilatation of the cervix is therefore required, and as a rule will have to be obtained by incision of the cervix and lower uterine segment (see p. 697). The enucleation itself may be difficult or impossible, for in some myomata the plane of cleavage between the tumour and its capsule is ill-marked and in adenomyomata does not exist at all. In such a case the operator must therefore either desist and open the abdomen, or must attempt removal by morcellation. This proceeding is a blind one, for the surgeon cannot see what he is doing and may cut deeply into the uterine tissue or even perforate it.

For these reasons removal of a sessile intra-uterine fibroid through the cervix is not a good operation as a rule, and should be reserved for cases of sloughing tumours in which enucleation is readily performed or in which the mass can be easily pulled away piecemeal.

In all others by far the quickest and cleanest operation is to open the uterus from above, enucleate the tumour guided by sight as well as by touch, and then restore the integrity of the organ by sutures.

THE AFTER-TREATMENT OF GYNAECOLOGICAL OPERATIONS

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I. ABDOMINAL SECTION

Immediate Treatment.—The convalescence from a surgical operation begins as soon as the patient leaves the operating room and is returned to her ward. Such procedures as may be necessary during or immediately following the operation, as transfusion, stimulation, etc., are properly regarded as part of the operation itself and are not to be considered here. The management of convalescence, then, commences with the removal of the patient to her room, during which time she should be under the constant observation of at least one attendant, preferably a nurse specially detailed for this purpose. Where possible, one of the assistant physicians, in hospital practice (an interne), should accompany the cart upon which the patient is lying well wrapped up in a blanket. The head is turned to one side and the lower jaw supported to prevent the tongue from falling back over the relaxed glottis. Whatever the nurse requires should be brought to her so that she need not leave her charge even for a moment.

In the ward her bed should have been prepared with fresh linen, a rubber sheet, and a draw-sheet snugly pinned over all. Hot-water bottles well protected by flannel wrappings are to be ready. The room should have been thoroughly aired and the temperature held at 68° or 70°. Light should be subdued, and no one admitted whose presence is not absolutely necessary. For these reasons it is preferable in hospital practice to maintain a small ward in a quiet part of the building where patients who have been subjected to laparotomy may be isolated for at least a couple of days.

As soon as the patient is returned to bed she is covered with a blanket and the hot-water bottles are arranged about her, care being taken that these are never allowed to come into direct contact with the skin. The best method of avoiding this is to have the bottles well wrapped in flannel, as has been suggested, or to make it a rule that they be placed outside the blanket. The nurse next notes the condition of the skin, which should be warm and moist. This simple sign will be absent in shock or haemorrhage. The pulse, respiration, and temperature are next noted. All of these findings should be set down in the nurse's record, and are the first items found there after the notation stating the time of leaving the operating room.

The patient's head should be kept low and turned to one side, with the jaw supported, thus allowing unobstructed respiration and the free escape of any vomitus. The nurse sits beside her to control these things and to administer oxgyen gas where ordered. In case the operation has been a serious or prolonged one, it is well to elevate the foot of the bed 12 or 15 inches, thus assisting in overcoming any shock present. Even when drainage has been instituted, this position may be wise for a few hours immediately following operation. Certainly only rarely will it be thought necessary to put a patient at once in Fowler's position, such an elevation of the head being a possible cause of shock and definitely contra-indicated by shock. The position of the patient for the first day is preferably on the back, though a pillow may be placed under the head after consciousness has returned. Relief is afforded also by gently raising the knees and keeping the legs somewhat flexed with a pillow. Except where drainage forbids, after forty-eight hours she may be carefully lifted to a lateral position, pillows or a rolled blanket being so arranged as to give support.

The bed-linen should be changed as often as it becomes soiled, the draw-sheet at least every day. Unless the patient's condition precludes being moved to that extent, the under-sheet is to be changed twice weekly. Meantime the bed-clothing is to be kept smooth and well arranged, and the pillows shaken out so that they do not become hard and uncomfortable.

Restraint of the patient may be required while recovering from the anaesthetic. Often she becomes noisy or hysterical and must be prevented from getting up. Tact and firmness on the part of the nurse will be put to the test in such cases, as the patient must be kept in bed and as quiet as possible at all hazards. At times it will be necessary to use straps confining her to her bed, and in such event it is better that none of her relatives be present. The shock of major operations is so severe that the patient usually is quiet, commotion being more frequent after the minor procedures. It should never be forgotten, too, in the case of patients suffering from some marked mental disorder, to have her placed in a room where the windows are barred. Such precaution will prevent those occasional but always most unfortunate occurrences whereby patients are killed.

Post-operative management depends very largely upon the nature of the operation. Since abdominal section implies a major procedure and vaginal section nearly always a minor one, it is best, for further consideration, to discuss the subject as applying to one or the other of these routes.

Emesis.—While chiefly due to the anaesthetic, vomiting is due in part to the operation, since it is more frequent and more pronounced after abdominal sections than those on other parts of the body. Where short and relatively superficial abdominal procedures make possible a nitrous oxide-oxygen anaesthesia, there will, in a certain proportion of cases, be no vomiting at all. Again, in the case of narcotic drugs administered before general anaesthesia, as the morphine-scopolamine combination, where relatively little ether is employed, vomiting is less persistent and less violent. Advocates of this method of narcosis favour its use also because there is less immediate post-operative pain. Where ether can be almost or entirely eliminated, as in section performed under local or intraspinous anaesthesia, emesis is proportionately decreased, though after-pain is proportionately more marked. It should be noted, as well, before going further, that patients poorly prepared for operation will suffer more from nausea. In the long run, however, there will be that series of cases where the anaesthetic must be more profound for deep pelvic work and extensive peritonization, and where ether is the only means of securing sufficient relaxation and exposure. In such cases post-operative vomiting will always be anticipated and usually experienced. Herman regarded this as a symptom of gastric catarrh, and advocated simply that the stomach be kept empty—a treatment which he acknowledged difficult to carry out because of the patient's thirst. In 1911, Graham,[1] in a series of experiments, demonstrated free ether in the stomach, and suggested the ingestion of olive-oil as an ether solvent. For a time this was thought to improve conditions considerably, but the method has not been generally adopted. Up to the present time, then, there has come into use no prevention or cure of post-operative vomiting. Ashton is a strong advocate of oxygen inhalations until consciousness begins to return, when vinegar is substituted until the patient is awake. He regards this method as one of the best remedies to prevent nausea and vomiting. Anaesthetic vomiting, pure and simple, does not last more than a few hours. Where a gastritis has been produced it may be prolonged for twenty-four hours—the

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[1] E. A. Graham, *Journ. Amer. Med. Assoc.*, 1909, vol. liii. p. 2094; 1910, vol. liv. p. 1043; *Journ. of Infectious Diseases*, 1911, vol. viii. p. 147.

'irritative' form of Bonney, not associated with any untoward symptoms, such as fever, rapid pulse, or abdominal rigidity.

Neurotic patients often display the most intractable vomiting, where there is the least reason to suspect any grave intra-abdominal lesion. Here the entire list of 'cures' may be used in turn with little or no result. On the other hand, some unusual method may suffice, and occasionally the vomiting ceases apparently without reason. An ice-bag over the epigastrium, or a mustard paste, may be sufficient. At times, too, a little brandy in hot water or a half-grain of morphine will serve more successfully. If necessary dry champagne may be tried. The amount of fluid evacuated does not increase, so that the only harm done is that food is not taken or retained. In prolonged cases, all food should be stopped by mouth and nutrient enemata given after colonic flushing and gastric lavage. Washing out the stomach with a tube may so annoy a neurotic patient that the emesis will cease.

Were it not for excessive thirst, nausea and vomiting could be overcome in a few hours by keeping the stomach absolutely empty and by flushing the colon with soap and water. These are the most effective measures. Nevertheless, in a short time sufficient gastric secretion is produced and is thrown up. Undoubtedly the most distressing nausea, as in the morning sickness of pregnancy, is that where the stomach is relatively empty, containing but a small quantity of its own secretions. Hence lavage would be the ideal treatment. Since passing a tube is often in itself a distressing procedure, the same end may be attained by allowing the patient hot water to drink. Given in teaspoonful doses every ten or fifteen minutes it may relieve the nausea or may eventually produce vomiting. Where the latter occurs, hot water in larger quantities, or hot normal saline solution, will wash out the stomach quite as effectively as the tube. Certainly the retching is not so severe where there are several ounces or a pint of hot water to be evacuated. It comes up easily and the stomach is then quiet. Eventually the hot water is retained, the stomach is washed out downwards, and then food may be safely given. Egg-albumin, weak tea, or meat-juice are the first forms of nutriment to be offered, and these in small quantities. Without flatulency, milk may be well taken. Finally, it should be stated that when nausea and vomiting have continued beyond forty-eight hours other evidences of peritonitis should be looked for.

Thirst.—The first complaint of the patient after a severe operation is that of thirst, and this is one of the hardest to relieve because of vomiting. It is due to loss of fluid by free perspiration during operation, to the loss of blood and serum incident to the operation, and it may be one expression of reaction to the physical assault of operation. In variable degree, too, the sensation of dryness in the mouth is caused by the administration of atropine preceding operation. Thirst may be prevented, therefore, in large measure by copious ingestion of water during the preparatory days before operation and by the administration of a pint of normal salt solution *per rectum* at once after the patient is returned to her bed. Thereafter six ounces of saline is injected every four hours. As stated before, hot water is given by mouth as soon as the nausea has ceased, and as soon as fluid is retained there need be no further complaint of thirst. During the few hours of vomiting, however, this may be the chief distress of the patient. The water should not be given warm, which is nauseating to many people, but as hot as tea is usually drunk, so that it may be sipped with a spoon. Cold water may be more refreshing in the mouth but does not allay thirst so well and is more apt to accumulate in the stomach. In flatulency it is therefore harmful. Ice, for the same reasons, should not be given. During the entire convalescence the patient should be encouraged to drink freely of water, especially the still mineral varieties.

Pain.—Most patients suffer from pain in greater or lesser degree during the first twenty-four hours after abdominal section. At times this pain seems to be limited to the wound, but oftener it is due to tension where the parietal peritoneum is involved, as in ventri-suspension, or where the broad ligaments are pulled upon, as after certain round-ligament shortenings. Again, less pain is experienced where the incision is a median one through the *linea alba* than where it is laterally placed, as in the muscle-splitting wound for appendicitis. Where it is not so severe as to produce restlessness or wakefulness, the patient is better without a narcotic. Usually this is not the case, however, and sufficient sedative should be given to prevent the exhaustion and depression which follow severe suffering. Morphine (gr. $\frac{1}{8}$ to $\frac{1}{6}$), if given at all, should be given during the first night, since the pain is then at its worst. While it favours distension, thus tending to unsettle the stomach, flatulency seldom appears until twenty-four hours after the operation; peritonitis and obstruction, which are masked by morphine, rarely take place until after forty-eight hours. The routine use of morphine, in any case, is most undesirable. Heroin (gr. $\frac{1}{12}$ to $\frac{1}{6}$) alone or combined with pyramidon or trional (gr. v) offers a very satisfactory substitute in ordinarily severe cases. In $\frac{1}{12}$-gr. doses it may be given every eight hours for three days after operation. After the pain of trauma has passed or been allayed, morphine is contra-indicated, distress now being due to intestinal colic. For this free evacuation of the colon and rectum is the treatment required. Neurotic patients will complain of great pain and appear most restless, though pulse and temperature are normal and distension is absent. Here morphine is to be particularly avoided, milder anodynes being of quite as much value. Where the pain during the first day is out of proportion to the nature of the operation and to the character of the patient, especially if the pulse is unduly rapid, some trouble at the operation site is to be suspected. Pain after twenty-four hours is due to distension, peritonitis, or obstruction.

At times restlessness or insomnia may persist without a continuance of the pain. Physiological methods of treatment are best here if sufficient. A sponge bath is often gratefully received, or a change in position suffices to induce sleep. Likewise a pillow under the knees, or gentle massage, will produce composure. In nervous patients, especially if exposed to the annoyances of the average ward, sleeplessness is seen without pain. Here again is an argument for the isolation ward following laparotomy. In both pain and restlessness, as usually seen after operation, Crile's[1] anoci-association method of preparation has proved to be of a certain definite value.

Persistent insomnia is a sign often preceding or accompanying peritonitis, intestinal obstruction, and post-operative insanity. It is also characteristic of toxic absorption, *e.g.* from the operation area. Ability to sleep readily after operation gives excellent prognosis for a speedy and uneventful convalescence.

Temperature, Pulse, Respiration.—Pulse and temperature should be taken and charted every six hours during the first ten days, thereafter twice daily where no complications have arisen. Where the patient is restless or hysterical, temperature *per rectum* is more accurate. As a rule it seldom rises above 101° or 102° F., occasionally not exceeding 100° F. This so-called post-operative rise is highest on the second day, after which it drops to 99° F. or to normal after the bowels are moved. The temperature may be maintained at 99° or 100° F. for a week for no apparent reason and without other untoward symptoms. A rising temperature after evacuation of the bowels, however, indicates beginning suppuration in the wound or a circumscribed peritoneal infection. A persistently high temperature is suggestive of stitch-abscess in the abdominal wound or of pelvic haematocele, especially towards the end of the first week. Worry, nervous disturbance, or too much company will occasion a sudden rise which, however, is not maintained.

The *pulse* is perhaps the most satisfactory guide to the patient's condition after operation. It should be taken and recorded with the temperature, and, as a general rule, it will be proportionately high or low. In the normal convalescence it will not go far beyond 100 during the first two or three days, dropping at the end of the second day after bowel-elimination. Its quickness during the first twenty-four hours varies according to the length of the operation, its character, and the amount of blood lost. The quality of the pulse becomes a most valuable guide to the experienced clinician. After the third day it should run about 80, full, even, regular, and soft. An increase at this time, following free catharsis, indicates infection, especially if accompanied by a moderate temperature, and tympany, or rigidity. With a pulse rate of 115 to 130 after the second day, the case is serious, while a rate of 140 goes with other signs of shock or haemorrhage. In excitement or hysteria the rate increases temporarily.

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[1] Geo. W. Crile, *Journ. Amer. Med. Assoc.*, 1913, vol. lxi. p. 1501.

Rapid *respiration* soon after operation indicates shock or haemorrhage. Later on increased breathing is associated with peritonitis, intestinal obstruction, or the various pulmonary complications. Where there is much abdominal pain the patient will breathe more superficially and hence with a slight increase in rate. Ordinarily, after the second day, or upon the cessation of emesis, the respiratory excursion becomes relatively normal, not varying much from 20 or 22 to the minute, full, deep, and rhythmical.

The Tongue and Mouth.—While not so valuable a guide, the tongue shows characteristic changes according to conditions. After the first day it should be moist but will have a white appearance as long as the patient is on liquid diet. In the more severe forms of infection or obstruction, it becomes dry and brown, fissured, and red or ulcerated. Frequent cleansing of the mouth is most gratifying to the patient. The nurse may use pledgets of gauze soaked in a cool solution of one of the mild antiseptics, such as a modified Dobell's solution. As soon as the patient has recovered sufficient strength she may have her tooth-brush. False teeth should not be restored until vomiting has definitely ceased. Where the lips are chapped or cracked, as is the case usually with corresponding conditions of the tongue, they will require frequent anointing with olive-oil or a bland ointment.

Urination.—Effort should be made to induce urination every ten hours. Spontaneous voiding should be the rule and catheterization seldom required. Micturition is encouraged by hot local applications, by steaming water in the bed-pan, or by letting the patient go for twelve hours before catheterizing. As in *post-partum* convalescence, some patients find it difficult to void while on the back. Where conditions permit, therefore, it is better to support the patient in a sitting or reclining position on the bed-pan than to use the catheter. The nurse should not do this, however, without special permission. Frequently where the ability to void naturally is once regained, it will be maintained regardless of position.

The first specimen should be sent to the laboratory for analysis and a second at the end of the first week. After that analysis is made only as may be indicated by special conditions. The amount of urine is diminished during the first seventy-two hours after operation, and more or less vesical irritability is present as a result of urinary concentration. Hence the total daily secretion should be measured and recorded. The hot water ingestion by mouth, and the normal saline enemata already referred to in the treatment of nausea and thirst, induce the best form of diuresis by increasing the amount of fluid to be excreted.

When the patient is unable eventually to void spontaneously, catheterization will be necessary every twelve hours. The use of the catheter two or three times is rarely followed by evidence of infection. Where, however, its use becomes necessary repeatedly, *i.e.* ten times or oftener, cystitis nearly always follows.

In using the catheter, then, emphasis must always be placed upon the technique of surgical cleanliness. The catheter should be a glass one, and sterilized after using each time, and then kept immersed in a sterile solution. The hands must be cleansed according to some definite and systematic method. The external genitalia must be likewise cleansed, particular care being taken with the region about the external urinary meatus. The nurse should have adequate assistance in the performance of this minor operative procedure. This becomes especially necessary where the patient is unconscious, is struggling from nervousness or hysteria, or where she is delirious. Owing to peculiar configuration of the labia or clitoris in some cases, or in very fat women, the urethral orifice is not always easy to find. In such cases the nurse should call more experienced aid—the head nurse, or the resident or attending physician. The insertion of a retention-catheter should never be entrusted to the nurse. Catheterization is one of the most important procedures in post-operative convalescence, and the possible danger to the kidneys, as well as to the bladder, arising from its slovenly performance, cannot be over-emphasized. For this reason it were far better that every nurse undertaking the care of surgical cases should have had some experience in operative technique in the operating room itself. Where catheterization is necessarily continued beyond the second day, it is well to give urotropin (gr. v) three times a day after the urine has been rendered acid by acid sodium phosphate.

The Bowels.—The importance of early and thorough catharsis has been brought out in considering emesis and pain. Only where the intestinal tract is directly involved in the operation, as in resection or appendectomy, should purgation be delayed until the third day. Where the stomach is unsettled, little will be gained by giving cathartics by mouth. Here enemata are usually sufficient. Some authorities, however, prescribe calomel in divided doses as early as twenty-four hours after operation, following it by enemata of soap and water and glycerin. Others employ magnesium sulphate or castor-oil as early as the second day if the stomach is settled, with a turpentine, soap and water enema following. Once peristalsis is well started it usually continues actively, so that a simple cascara sagrada laxative, or the aloin-belladonna pill, or podophyllin suffices. In giving any of these preparations it is well to watch the individual idiosyncrasies of the patients. While most women are chronically constipated, some are not. Some patients will apparently reveal as much distress during the second and third weeks from five-grain cascara pills, for instance, as they do at once after operation. While routine treatment is essential in hospital practice, particularly in the larger wards, yet the routine should be so flexible as to be readily adjusted to the individual requirements of each patient. In the majority of cases this adjustment leads towards repeated and strenuous efforts to overcome chronic intestinal stasis, particularly that type aggravated by mechanical obstruction due to enteroptosis. Here repeated enemata are in order, soap and water containing an ounce of glycerine or half an ounce of turpentine, placed as high up in the colon as possible by means of the long tube. Such treatment is only for the immediate convalescence, however. As soon as conditions allow food, constipation should be treated by a carefully formulated anti-constipation diet. It is always well for the patient to be well started on this regimen before leaving the hospital. In this connection, too, the annoyance of haemorrhoids as a complication is not to be forgotten. Fortunately, however, this very troublesome condition is rather improved by the enemata and rest in bed than aggravated. A great mistake would be made by removing haemorrhoids as an incidental procedure in a complex gynaecological operation. In any case where it may be subsequently necessary to pass the rectal tube, as in any laparotomy, coincidental haemorrhoidectomy would render the use of the tube well-nigh impossible.

The colon-tube is also of inestimable value as a means of relieving the patient of flatus. Post-operative distension is one of the first conditions calling for treatment; it has been discussed in the paragraphs devoted to pain. While early catharsis, as has been stated, is the cure of this distressful condition, the colon-tube may be passed at the end of twelve hours, where tympany appears so soon. It may be passed several times a day and may be left for half an hour or so at a time. In this way flatus is expelled readily, without the bearing-down effort on the part of the patient which is apt to be so painful. Assistance to this method is provide by strychnia sulphate (gr. $\frac{1}{20}$) or eserine salicylate (gr. $\frac{1}{40}$) or by pituitrin. This last preparation is particularly effective in the more obstinate forms of simple distension and in those cases already referred to, characterized by muscular insufficiency and prolapse. Stevens,[1] who prefers 1 c.c. of a 20 per cent solution of pituitary extract, also uses a mixture of eserine salicylate (gr. $\frac{1}{40}$), digitalin (gr. $\frac{1}{50}$), and strychnia sulphate (gr. $\frac{1}{60}$).

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[1] Thos. G. Stevens, *Diseases of Women*, 1912.

The temporary influence of pituitrin and its contra-indication in pathologically increased blood-pressure must not be forgotten.

Management of the Wound.—The superficial skin-stitches are removed on the eighth day, the deeper retention sutures on the tenth or eleventh. Michel's skin-clips require removal on the fifth day. Up to this time the dressings should not be disturbed unless the temperature goes up, the patient complains of pain in the wound, or the dressings become stained with blood. The wound is sponged, after removal of the stitches, with alcohol and touched along the line of scar with tincture of iodine. Hydrogen peroxide will aid in freeing the deeper layers of gauze which may have become adherent. In redressing, fresh material should be used throughout, the original adhesive strips having been entirely removed. Gauze is first placed over the wound abundantly and over this very little cotton, if any. Some very experienced surgeons advocate wet dressings, such as gauze saturated in corrosive sublimate solution (1 to 1000), placed directly over the wound, dry dressings above this. In the opinion of the writer, however, it is far preferable to maintain a dry field so long as it is a clean one. In securing the fresh dressing material, the best method is to employ shorter lengths of the adhesive straps. These are fastened well around the patient's back and hips, the free ends being folded in upon themselves for about two inches so that they may be perforated. In these perforations short tapes are tied. When all is ready the opposite ends of the straps are four or five inches apart. The tapes are then tied in a double bow. This forms as convenient a method of abdominal dressing as has been devised, giving ready access to the wound and having the greater advantage that, in subsequent dressings, the adhesive straps do not require removal at all. Over all a scultetus binder is placed, to be worn until the permanent abdominal support is provided.

Drainage.—Where skin-drains are used, as in very obese patients, they should be removed as early as the fourth day. Gauze that has been inserted to check haemorrhage is to be removed in twenty-four hours, the hole then being closed by a suture placed but left untied. Where drainage has been employed because of suppuration, the dressings must be changed as often as soiled. This may mean several times daily, and should be done at least once daily. After forty-eight hours the rubber tube is entirely withdrawn, or left in according to the duration of the discharge and its amount. In the average case the tube may be shortened a little each day after the second or third. Where the cigarette drain has been used, a simple rubber tube may take its place if necessary. The glass tube remains only as long as material may be aspirated through it. In no case should a drainage tube be left *in situ* too long, and in no case should an abscess cavity be irrigated through the tube. It should go without saying that the tube must be fixed at its outer end in order to prevent its slipping into the abdominal cavity. Unless contra-indicated by shock, in all drainage cases the patient should be raised into Fowler's position (the half-sitting posture) where strong enough, otherwise by having the head of the bed elevated about two feet.

Where the operation has been extensive, as in the Wertheim hysterectomy, or where the ureters have been directly involved, evidences of urine on the dressings should be looked for. Likewise where the intestine has been involved, or its continuity impaired, as in resection, faecal discharge should not be overlooked. It is important to impress the significance of these two points upon the nurse.

Where a permanent catheter has been introduced, as in bladder injuries, this should be connected with a tube leading to a stoppered bottle which, in turn, is tied to the side of the patient's bed. This bottle should be large enough to contain the normal urinary excretion for twelve hours, so that it will have to be emptied and cleansed as often as twice daily.

Diet.—An ounce of brandy with the first retention-enema constitutes the first nourishment. Until the bowels are moved and the stomach is quiet it is best not to attempt feeding by mouth. But after thirty hours egg-white, beef-juice, or weak tea may be given and for some patients a slice of buttered toast may be added. Milk is best left out of the dietary for two weeks as it increases flatulence and hence nausea and vomiting. After the stomach is quiet it may be given in a peptonized form, or with lime water. Cooled orange juice is very acceptable as soon as liquids can be retained. Alcoholic stimulants should be given only on definite indication, the best forms being whisky, brandy, or champagne. After two days of liquids, a soft diet is to be substituted, then a light, and finally the full tray for the third week. This dietary may be advanced somewhat more rapidly where the operative procedures have not involved the intestinal tract. Prolonged gastric distress, not due to grave complications, does not contra-indicate solid food, as many patients do better as soon as the so-called 'slop diet' is discontinued. After regular diet is in order, nourishing liquids should be offered between meals, such as cool fruit juice, hot chocolate, koumiss or matzoon, egg-nogg, etc. The following diet-list indicates such food as may wisely be given in regular hospital service :

Liquids.—Six to eight ounces every two hours of meat broths, milk, malted milk, buttermilk, cocoa, tea, coffee, albumin water, egg-nogg, milk-punch, lemonade, orangeade, ginger ale, seltzer water, etc.

Soft Tray.—Milk toast, soft eggs, cereal breakfast foods, oysters, chicken meat, scraped beef, bread without crust, orange sherbet, and ice-cream. Milk with each meal, coffee for breakfast, and tea with supper. In the second week may be added dry toast, baked potato, baked apple, asparagus, farinaceous puddings, egg-custard, rice, etc.

Light Tray.—This includes the soft diet, to which are added whole bread, broiled steak, chops, chicken, white fish, cod fish, finnan-haddock, scraped beef, squab, quail, and stewed fruits. The coarser vegetables should only be allowed when especially ordered.

Full Tray.—Food as desired, suitable for convalescence.

Toilet of the Patient.—By the end of the second day the patient should be given a complete sponge bath, except that the back may be left alone if for any reason she should not be turned. The bath is repeated every day during convalescence, and the hands and face are washed three times daily with soap and warm water. A cool sponge bath at evening followed by an alcohol rub will often induce refreshing sleep. For headache an ice-bag is of great benefit, and in very warm weather the electric fan will add much to the patient's comfort. After defaecation and urination the perineo-anal region must be carefully cleansed with soap and water followed by an external douche. After the third day a daily vaginal douche of warm water is given. The patient is allowed her tooth-brush as soon as she is strong enough, and her hair is combed and braided every morning and evening. The care of the patient is much facilitated by placing her in a short plain gown which opens in the back and ties by tapes. These are usually provided by the hospital and greatly simplify the nurse's arduous duties. There should be one for night and one for day wear, being changed oftener if soiled. No underclothing should be worn in modern hospitals where heat and ventilation are adequate. After the first week, conditions being normal, the patient may have her own gown and boudoir cap during the day.

Visitors.—During the first week absolute rest and quiet are essential. It is imperative that no visitors be admitted during the first three days, though exceptions have to be made to this rule in the case of the nearest relatives. These should be kept away as much as possible. After the first week guests may be admitted two or three at a time and allowed to remain but a few minutes. Where the patient is nervous and restless, or where there are any signs suggesting complications, the rule of the first week must be enforced. In ward practice not more than two visitors should be allowed any patient at one time, and visiting hours should be definitely limited to two hours on three specified days during the week.

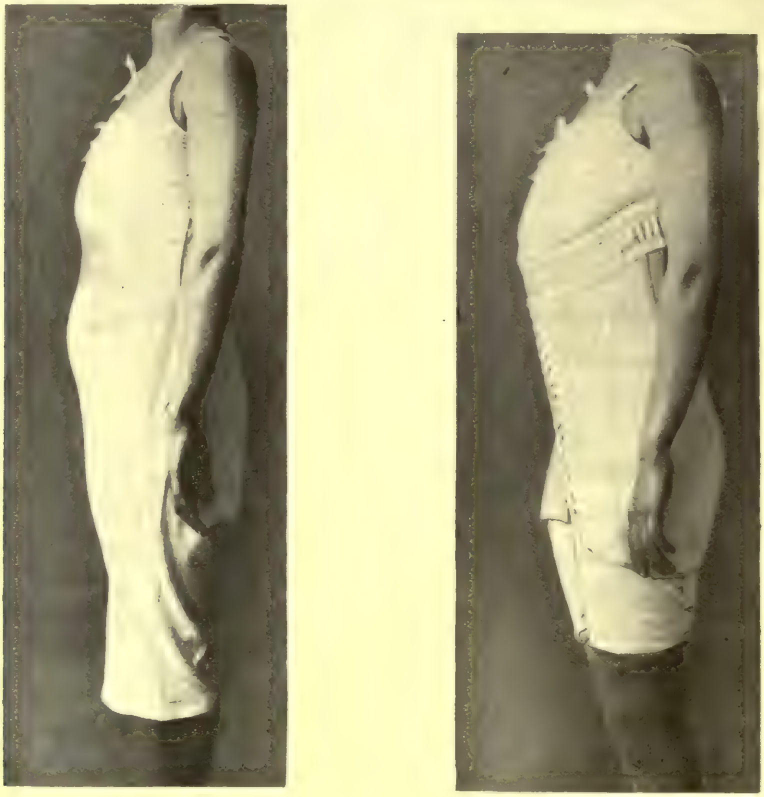
Rising from Bed.—The patient is given a back-rest on the fifth or sixth day, and allowed to have her dressing-gown and to sit up in a chair on the ninth. She will usually want to go back to bed in thirty minutes or an hour on the first morning, but may try it again for a like period in the afternoon. The chair should be a comfortable one, wide-seated and high-backed. From this time onwards, her activity depends largely upon her own ability, guarding merely against over-ambition. As soon as she can remain out of bed for several hours she is given a wheel-chair and may be taken to the sun-pavilion. The stitches are removed on the tenth day and by the fifteenth she is sufficiently active to leave the hospital. The only argument that can be advanced against a longer period in bed, as advocated by certain clinicians, is that some patients do not require more rest. A large proportion of patients, however, are run down and anaemic, or are exhausted and neurasthenic from prolonged suffering, and are only benefited by two or three weeks in bed. Many patients require a genuine rest-cure, and rules for them should not be made to apply to the more robust.

As to the opposite method of treatment, whereby patients are gotten up on the second or third day after laparotomy, the writer's experience has not included it. The type of cases first referred to, such as fill our large charitable wards, certainly are not adapted to it, and private patients seem to be satisfied to remain in the hospital for two or three weeks where their means permit.

Drainage cases also find it necessary to remain in bed for a longer time, the period varying according to the amount and duration of the discharge. These patients are not on their backs, but lie rather on the side and usually in the elevated (Fowler's) position. Small stitch-hole infections that have been treated do not prevent patients from having a chair. Those who are asthmatic, or suffer from bronchitis or certain forms of valvular heart lesion, are propped up on back-rests as soon after operation as possible, and are given chairs when conditions permit.

Abdominal Support.—In a certain proportion of cases patients whose wounds have healed normally probably do not require post-operative support to the abdomen. Yet most surgeons of extensive experience prefer that in every case the abdominal wall be relieved of the strain of intra-abdominal pressure and of the accidents possible to ventral section. The presence of some sort of a binder, besides, is a constant reminder to the patient of the tender condition of the wound, and tends to guard her against overstrain. The elastic abdominal belt is entirely inadequate to provide the support required, as it very soon loses its tension, and is unclean in addition. If abdominal belts are desired, by far the best are such as are made of inelastic white goods that may be laundered. Two of these are necessary and need to be worn only while the patient is out of bed. If worn, this bandage should be used for from three months to six months. Only in exceptional cases need it be used longer.

In the opinion of the writer, by far the best abdominal supporter is a hygienic model of the corsets. These should be of the straight-front variety, laced in front, with girdle top, and coming down well over the hips so as to give proper support to the abdomen from the symphysis up (Fig. 288). The patient is measured for this garment and it is fitted to her by an expert corsetière. It is adjusted while the patient lies on a five-foot ironing-board, with the limbs flexed and the shoulders and head low. She should put it on in the morning when she rises and wear it until she retires at night. The value of such corsets is unappreciated by clinicians who have never employed them, and many patients attribute their subsequent good health to this after-care almost as much as to the operation. Particularly in the case of visceral ptosis, or the pendulous and diastatic abdominal wall, do the straight-front corsets prove of value. Here they become a definite part of the treatment and cure. They possess the added advantage of making it possible for her to dress becomingly, a factor impossible with the old-fashioned belt. Only with the hard-working peasant type of woman is this garment ill-advised, as they will soon cease wearing them because never used to corsets in any form.



Figs. 287 and 288.—A corset abdominal support showing effect of application to an exaggerated feminine type with ptosis.

General After-Treatment.—For six months to one year after operation the patient should take reasonable care, avoiding undue physical effort. Passive exercises and calisthenics are excellent in moderation, particularly in that type of woman characterized by incorrect posture. The value of massage as an aid to recovery is generally under-estimated. A course of treatment in the hands of a skilful and experienced masseuse will give the patient so treated a distinct advantage over the woman who goes without. Straining at stool and on urination is to be avoided; hence laxatives will be indicated and at times diuretics. For a time, too, tonic medication comes in wisely. The usual iron, quinine, and strychnia combination may be given three times daily. Preferably the bitter extract of cascara sagrada, combined with the tincture of nux vomica in a vehicle of lactated pepsin is taken in the same dosage.

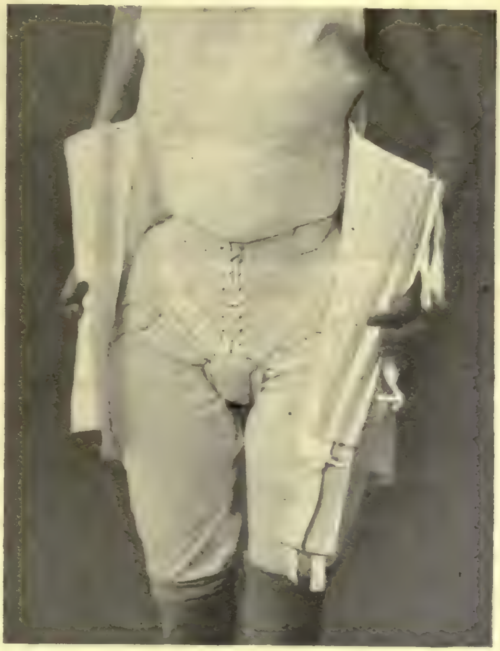


FIG. 289.—Showing the corset with inner belt adjusted.

For the ptotic type of patient, for whom walking is so fatiguing that she will not follow it up, the writer[1] has for many years employed special exercises for the muscles and for correction of bad postural habits. These exercises are of two varieties, those practised in connection with postural treatment in the Trendelenberg position and those practised while wearing the abdominal support in the upright position.

The individual with the marked type of ptosis is required to arise from her bed each morning and assume a position on her back upon the extemporized Trendelenberg table, without a bandage (Fig. 290). While in this position, simple active muscular exercises are indulged in. In order to systematize these exercises and classify them for the purpose of giving instruction to patients or to nurses who have charge of the cases, a few simple manœuvres are here outlined. The *first movement*, frequently prescribed for convalescent patients who have the ptotic habit and have been subjected to surgery because of intercurrent difficulties or complications of ptosis, consists in the slow flexion of the leg on the thigh and the thigh on the abdomen, without unflexing or extending the leg and without lifting the foot from the bed. Figure 291 depicts this simple act with either limb. Figure 292 is the same manœuvre with both limbs. As this is one of the simplest exercises and is reserved for convalescent patients it is carried out upon a cot at the side of the patient's bed, the end of which is elevated by placing a chair under it to secure the Trendelenberg position. The regular routine exercises hereinafter described are best carried out on an ordinary ironing board employed as a convenient substitute for the Trendelenberg table (Fig. 293).

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[1] F. H. Martin, *Surg. Gyn. and Obst.*, Aug. 1912, p. 150.

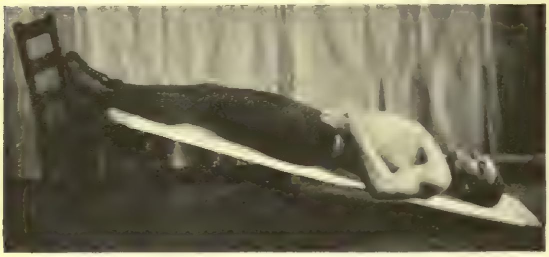

Fig. 290.—Position advised for exercises described for ptotic patients.

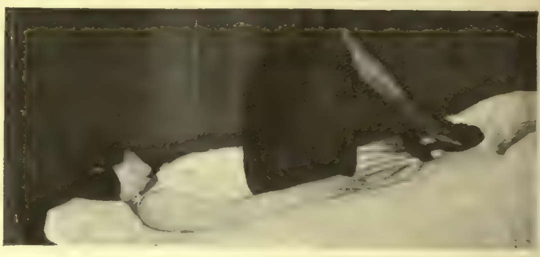

Fig. 291.—Movement one, consisting of flexing leg upon thigh and thigh upon abdomen.

Movement two consists in slow, extreme expansion of the chest by deep inspiration and slow expiration. This is the most important exercise that can be prescribed for a ptotic patient, and for that reason it is insisted upon as an alternate movement in connection with all the others. To secure the best effects in ptosis, this exercise should be practised in the Trendelenberg position and should be performed with (*a*) pressing both hands upon the lower abdomen toward the diaphragm, (*b*) elevating the shoulders with arms extended slowly at right angles to the sides (Fig. 294), and (*c*) elevating the arms above the head perpendicular to the body. This movement brings into play the diaphragm, the abdominal muscles, the back muscles, the depressors and levators of the ribs, the shoulder

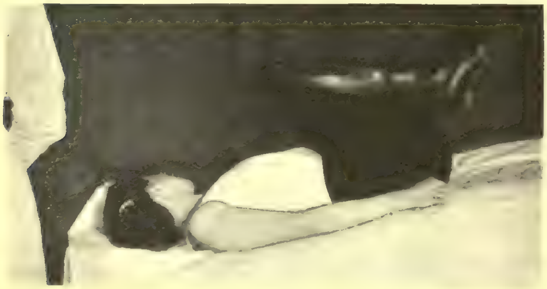

Fig. 292.—Second act of first movement.

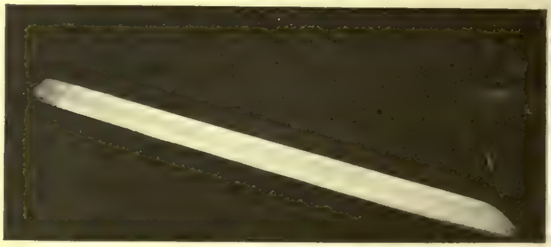

Fig. 293.—Simple and inexpensive means of obtaining Trendelenberg position.

muscles, the strong pectoral, the trapezius, and even the strong cervical group of muscles.

The *third movement* is the elevation of the lower extremities at right angles to the trunk, with preliminary knee flexion (Fig. 295); then slow flexion at the knees, followed by extreme flexion of the thighs on the abdomen; and finally slow extension to the original position. This movement may be carried out (*a*) with one limb at a time, or (*b*) with both limbs simultaneously. These two movements, when properly accomplished, exercise some muscles that are seldom brought into extreme action by the ordinary use of the extremities; especially is this true of the deep psoas muscles, the deep posterior sacral and back muscles, and most markedly the recti and pyramidalis muscles of the abdomen.

The *fourth movement* consists of slowly elevating the lower portion of the trunk on the soles of the feet and back of head and shoulders. This obviously brings into play the strong extensors of the back, the lumbar, dorsal, and posterior cervical group, the anterior muscles of the thigh, and the front and lateral muscles of the abdominal walls.

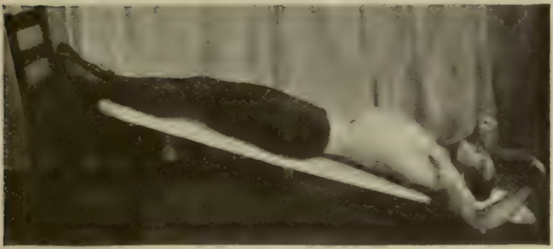

FIG. 294.—Movement two. Consisting of exaggerated expansion of the chest with arms above the head or, as in Figure 290, with pressure of hands over the lower abdomen.

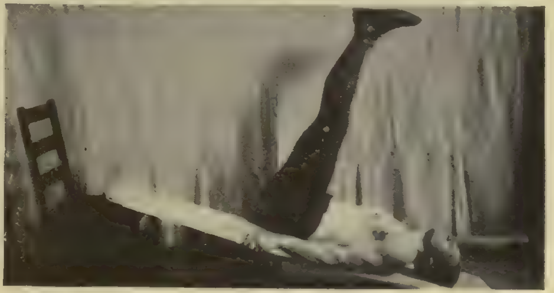

FIG. 295.—Movement three. After extreme extension of limbs one at a time and then together, leg is flexed upon thigh and thigh upon abdomen, followed by return to extended horizontal position.

A *fifth movement*, employed with the stronger patients, consists in raising the body to a sitting position with the hands by the side, or if necessary at first, by grasping the edge of the board with the two hands to assist in the movement.

These movements are the important ones, and rather than add confusion by multiplying them, they may be slightly modified. To exercise the adductor and abductor of the thighs, and particularly to reach the little obturator and pyriformis, which are both outside and inside of the pelvis, in a *sixth movement*, the patients are instructed (*a*) to separate the knees widely with the two feet parallel, with the soles flat on the board, (*b*) a more difficult exercise, with the two feet extended at right angles to the body, slowly to separate them to the extent of comfort.

Patients who are weak and unaccustomed to active exercise are assisted at the beginning by the nurse or a nember of the family until such time as they can exercise by themselves.

There are three influential factors that may be utilized in these cases in the gymnastic and postural treatment: (*a*) replacement of the displaced uterus by the knee-chest posture; (*b*) ballooning the vagina and sometimes the rectum by distending them with air; (*c*) aiding these two measures by contracting and relaxing the abdominal muscles and the diaphragm. The exercise consists of three movements in the hands-and-knees position either on a level surface, or better, an inclined plane. The (*a*) movement is slow, deep inspiration and expiration of the lungs in the knees-and-hands position, (*b*) lowering the upper portion of the body so that the chest and knees will be in contact with the board, (*c*) deep inspiration and expiration while in the last or true knee-chest position; finally returning to the knees-and-hands position.

These movements may be repeated slowly from knees-hands to knee-chest and back again, with deep breathing interspersed. This manœuvre is usually prescribed as the last one of the series of exercises. The patient is then instructed to assume her bed or couch in Sims' position for rest.

At the beginning it is well to prescribe a few movements, carried out slowly, ten to fifteen minutes' time being allowed morning and evening. As the patients develop muscular strength, the movements may be increased from three or four of each of the principal movements properly alternated, to six or eight or even ten of each carried out more rapidly and occupying from fifteen to twenty minutes' time for their execution.

In ptotic cases the bath and rub-down, consisting of a sponge bath in convalescent cases, with a coarse towel-friction rub, should be given in the recumbent, or better, the Trendelenberg position. Then, after the required rest, the corset supporter should be applied, with the patient in the same position. She should then be allowed to rise. The patient should be enjoined to avoid carefully the compensatory stoop while in the standing or walking position. With the abdomen properly supported, and the viscera at their normal height, hugging the posterior parietes instead of dangling forward far from their normal attachments, the desire for the forward bend is partially eliminated, and the individual finds that she can more easily maintain her normal position because the normal centre of gravity is restored. It is but a step now, when the patient finds that she can walk with ease, without the feeling of weakness and insecurity in the abdomen that formerly compelled her to adopt the ptotic attitude, to the time when she will gladly walk long distances and adopt other outdoor exercises which will develop muscles naturally and give her an appetite for nourishing food and refreshing sleep.

Walking is by far the best exercise, swimming and golf in moderation coming after a time. Tennis and basket-ball are always strenuous and not to be indulged in until one year has elapsed. Sexual continence should be maintained for eight weeks after operation and pregnancy delayed for the following year.

The greatest difficulty in the after-care of the patient comes with the woman who must work for her living, either by returning to shop or office, or to the modest home where husband and children need her care. A trip abroad or to the seashore may be prescribed for the woman of fortunate circumstance. For the other, the convalescent home is the only boon, and this usually for too short a time. At least six months should be considered as the proper time for convalescence from an abdominal operation. It is unfortunate that better facilities are not offered by the various charitable associations for the subsequent care of these women, whereby they might be cared for and re-trained to return to their several occupations of livelihood.

II. Vaginal Section

Virtually all that has been stated up to this time should be made to apply to the after-care of patients operated upon by the vaginal route and, indeed, does apply in the case of major procedures, such as hysterectomy or other invasions of the peritoneal cavity. Since the anaesthetic is seldom so profound or so prolonged as in laparotomy, emesis is of much less import. Many minor procedures, such as cervical dilatation or uterine exploration, can be done under nitrous oxide narcosis, entailing little or no gastric distress. Drainage being better, with slight post-operative absorption, the temperature should return to normal in twenty-four to thirty hours and deviate but slightly throughout convalescence. Pain may be very severe after extensive work, such as hysterectomy or vaginal fixation of the uterus where traction is exerted on the peritoneal folds. It usually is severe also after deep plastic repair, especially if the rectum is involved. Morphine is often required during the first night, or one of its derivatives, preferably heroin (gr. $\frac{1}{12}$). At times patients complain bitterly of the irritation of stitches in the perineum, when relief can be obtained with pyramidon or sedatives, such as trional or adalin. Hot moist packs to the perineum are valuable here, especially with the hot-water bag, and have the added advantage that they may be made antiseptic. Pain is also caused by gauze packing, especially in the uterus. In such cases the gauze may be removed on the evening of the second day, so that the patient's second night may be a restful one.

The Bladder.—After minor operations urination is spontaneous as a rule. After plastic work on the anterior vaginal wall, especially for cystocele, patients may be unable to void and require catheterization a few times. This is true also where a tight packing has been placed in the vagina. As a rule perineal stitches are not endangered by spontaneous voiding, but higher plastic procedures, such as excision of the vulva or work about the external urinary meatus itself, where stitches are exposed directly to contamination, require the use of the catheter. Following injuries to the bladder or urinary fistula closure, the self-retaining catheter will be necessary. As a general rule, however, the patient should be encouraged to pass the urine herself, even to the point of raising her up in using the bed-pan after the third day. Following simple curettage she may be allowed to slide down over the edge of the bed on to the slop-jar.

The Bowels.—After major operations, the control of the bowels should stand as already described under abdominal section. After minor operations they should be opened on the morning of the second day. An ounce of castor-oil followed by a soap and water enema as soon as the desire for defaecation comes on is an excellent routine procedure. The bowels are then kept regular by cascara sagrada (gr. v) every day or so, as may be required. The management of the bowels is of greatest importance when the operation has been of a plastic nature, involving the rectum. In the repair of the completely lacerated perineum, as a type, the bowels should be kept closed for four days. On the fifth purgation is started with castor-oil, followed in this instance by six ounces of olive-oil placed in the rectum with a small rubber colon-tube. The hard rubber rectal tip should be avoided here, as should the large water enema. Thereafter evacuation should be assisted each morning by enemata until the stitches have been removed. In some cases where the injury had involved the rectal wall above the sphincter a small tube wrapped with gauze and well smeared with sterile petrolatum is placed in the rectum at the time of operation, as is done after haemorrhoidectomy. This prevents flatus from distending the rectum above the line of suture and thus putting undue tension on the softening catgut. It may be necessary in some cases to use opiates in order to prevent defaecation before the allotted time, though this is unusual. The method employed by some surgeons of keeping the bowels acting from the first places upon the nurse a greater responsibility of keeping the wound scrupulously clean, a relative impossibility. Certainly the former method is in better accord with general surgical principles.

Care of the Wound.—1. *Dressings.*—While it may seem difficult to maintain a clean wound after vaginal plastic operations, the advantage of ready drainage is always present. Hence dry, sterile dressings, frequently changed, are all that is necessary. All dressings, no matter of what nature, must be changed as often as soiled. Nearly all failures in plastic repair are due to infection from faeces, vaginal discharge, or urine, and the importance of local cleanliness cannot be over-emphasized for the nurse. With adequate assistance the nurse or house physician can readily change external dressings as often as necessary without touching the wound with other than sterile instruments. At the time of dressing and after defaecation and urination the wound should be douched externally with sterile water or the normal saline solution. Only where the discharge becomes positively purulent will antiseptics be indicated. This douche may be given with an irrigating tube or with a simple pitcher. Where the irrigator is used the sterile glass tip need not come in contact with either the nurse's hands or any part of the patient. Between the douches the dressing should remain undisturbed, as too much interference will do as much harm as too little. The patient should keep quiet in bed but need not remain on her back. As a rule, following extensive plastic work, she will be more comfortable on her side. The legs, however, are better tied together at the knees for two days and longer if she is very nervous or restless.

Where the wound has broken down, demanding antiseptic treatment, the formalin-glycerin solution described by Webster is unexcelled. This consists in formalin (♏ xv) with glycerin (℥ vi), the two diluted with sterile water to make one pint. Placed directly against the wound, this dressing is covered with oiled silk, after which a T-binder is applied. The hot-water bag may be used or not, according to the comfort of the patient.

2. *The Vaginal Douche.*—The vaginal pack is removed in forty-eight hours and a two-quart douche of warm salt solution is given. This is repeated daily, or even twice daily, according to the amount of discharge. Only in the case of definite infection will lysol, iodine, or formalin solution be necessary. Following hysterectomy the douche should be omitted during the first week. After many minor operations a saturated solution of boracic acid, or even sterile water is sufficient. It should always be used warm, never too hot nor cold. The nurse should be especially guarded in passing the douche tip, a sterile glass one, in cases where the anterior or posterior vaginal walls are involved in sutures. Bichloride of mercury or carbolic acid for douching is not regarded with favour by the writer. Formalin or iodine is much preferred on mucous-membrane surfaces where antisepsis is desired.

The vaginal douche should never be given with much pressure, the irrigator hanging preferably just above the patient's hips which are slightly elevated by the douche pan. With the head and shoulders flat on the bed, this enables the irrigating fluid to flow gently in as far as the vaginal vault, with enough pressure for the return current. Finally, the douche as an operative procedure demanding surgical cleanliness on the part of both nurse and patient, must be emphasized here as was catheterization in a previous paragraph.

3. *Gauze Packing.*—Strips of gauze are often left in the uterus after dilatation, curettage, and the removal of polypi, and in the vagina after operations on the cervix or vaginal walls. Packing above the vaginal vault might occasionally be employed for haemostasis. It may be stated definitely that such gauze should never be left in longer than two days, and after minor operations may be removed in twenty-four to thirty-six hours. Gauze should always be removed gently and slowly, especially where it has been inserted to check bleeding. Removal is facilitated by leaving the end of the gauze outside the vaginal introitus, so that it may be readily seized. Where such precaution is not taken, it may be necessary to anaesthetize the patient in order to find the strip. Again, where two or more strips are used, they should be tied together in small hard knots, notation being made in the case-record of the number of pieces, so that they may be checked off properly when removed. Too often a piece of gauze capable of causing malpractice action has been unnecessarily left behind. Again, the responsibility for the removal of packing should be definitely placed upon one of three individuals—the nurse, the house physician, or the attending surgeon.

4. *Removal of Stitches.*—The external lines of suture should be examined on the fifth day for, as a rule, if the wound is breaking down, this will be shown by this time. Where ligatures have been tied too tight, or are cutting through oedematous tissue, they should be removed at once. Ordinarily stitches are removed on the tenth day. After this time silkworm-gut and metal sutures only produce irritation. Where non-absorbable suture material has been used within the vagina, as at the cervix, it may be necessary to give the patient a few whiffs of nitrous oxide for their removal. Taking out the stitches should not always be left to the assistant, who may not be skilful. A patient intractable in his hands may exhibit no distress at all when cared for by the surgeon.

Drainage.—The natural relations of the uterine and vaginal mucous membranes usually offer sufficient chance for drainage after the gauze packing is removed. Retention of material that should be discharged is further prevented by the vaginal douches. Drainage, then, as instituted by means of tubing or gauze, practically is limited to the evacuation of a pelvic abscess. As a rule gauze is first employed at the time of the colpotomy incision. Removal of this should commence in twenty-four or thirty hours and should be done gradually, ten or fifteen inches being extracted each day. At first this necessitates care, and may be so painful to the patient as to demand an anaesthetic. Later on it comes away more easily. After the complete removal of the original packing, the case is treated in one of three ways, according to the profuseness of the discharge: first, the wound is left open and discharges out spontaneously in a few days; secondly, fresh gauze is again introduced with the dressing forceps every day so long as necessary; thirdly, a rubber tube is inserted through the vaginal wound well into the abscess cavity and fixed there by fastening it to the external dressing. Where the first method is sufficient, the patient may leave her bed in one week. Unfortunately the vaginal wound, not being as low as the floor of Douglas's *cul-de-sac,* may close up before all broken-down material has come away. In this case the abscess recurs or the wound must be reopened. The second method is best where drainage is not too prolonged, but is more difficult and painful in execution. Hence, in cases of prolonged discharge, especially where the abscess proves to be tubal in origin, the rubber tube is productive of best results eventually. Cases of general or localized suppurative peritonitis, where vaginal drainage is instituted in addition to or without abdominal drainage, are dressed in the same way. After the gauze or tube is finally withdrawn the patient is allowed to be about on her feet, and should receive one or two vaginal douches every day until all discharge has ceased.

Diet.—A few hours after most minor operations liquids may be given. As long as the patient is confined to bed the diet should be light; later ordinary diet in amount sufficient to satisfy the appetite is allowed. Liquid diet should be maintained until after the bowels are opened well, in case the rectum has been involved in perineorrhaphy.

Getting Up.—The length of time a patient should remain in bed after plastic perineal work is debatable. Some experienced clinicians take the ground that the wound is endangered by the strain of assuming the upright position before twenty-one days, and that discharge from the hospital should not occur until four weeks have passed. Certainly where scar-tissue is abundant the patient cannot sit down comfortably by the time the stitches are removed. On the other hand, where the operative work has been more superficial, such danger of recurrent relaxation and discomfort does not exist, and the patient may safely sit up on the tenth day, leaving the hospital by the fifteenth. A middle ground is therefore the wiser to take, varying the length of confinement, in the case of private patients, according to the individual's condition. After hysterectomy and prolapsus operations the longer period of rest in bed is essential to perfect recovery.

On the other hand, following minor procedures, where the perineum is not involved, the patient may safely leave her bed at the end of one week and go home on the tenth day. Frequently, after simple curettage or divulsion, the woman gets up on the fifth day and departs on the eighth.

Menstruation.—The recurrence of menstruation following operative procedure varies considerably. As a rule, perhaps, it is not greatly interfered with. Yet one frequently sees the case where uterine bleeding is irregular for a time, more often too frequent and rather profuse. On the other hand, after minor procedures a short period of amenorrhoea occasionally supervenes. Thus, after a simple curettage the patient may miss two or three menstrual periods. Halban has recently brought to bear on this question the light of his clinical experience. In considering the relation of the corpus luteum to menstruation this author has made an interesting observation. Where the corpus luteum was removed but the ovary left, the time of operation being at once after menstruation, no change occurred in the menstrual order. Where, however, the corpus luteum was destroyed during the second half of the interval, menstruation took place one or two days after the operation, the next period following in four weeks, thus establishing a new time for the cycle. This will aid in advising the patient as to when she may expect the re-establishment of this always important function.

In general, the point should again be made that patients who are run down, anaemic, nervous, or neurasthenic should remain recumbent longer. Tonics and laxatives will be required according to indication, and the general management should conform to the rules governing convalescence after abdominal section.

The use of the pessary in connection with operations for prolapsus, or of the intra-uterine stem after divulsion for dysmenorrhoea or sterility, becomes strictly a part of such procedures. Their consideration belongs, therefore, more properly to the chapters devoted to these subjects.

COMPLICATIONS FOLLOWING GYNAECOLOGICAL OPERATIONS

Shock

The nature of this most terrifying complication is as yet very imperfectly understood. Various theories have been offered and each is combated in turn. Until some generally accepted explanation is evident, therefore, a definition will be impossible. For the present we can only say that shock is recognized from relatively clear symptoms, something is known as to its cause and prevention, and a fairly definite treatment may be outlined.

As to the *cause* of shock, three generally accepted factors predominate: first, where operations are prolonged ; second, where such prolongation is accompanied by considerable loss of blood ; and third, where trauma has been extensively produced. In consideration of shock following abdominal or pelvic work, these three factors comprise virtually all that need to be taken into account. In a broader study of the subject certain other points would need be brought out, as, for instance, that shock following burns is of a septic nature.

As to its *pathology* a very short summary must suffice. While Crile's theory that shock is an expression of exhaustion on the part of the vasomotor centre is very generally accepted throughout the clinical world, certain other theories are more attractive from the physiological point of view. Henderson's experimental work tends to show that, in certain forms at least, shock is produced by a diminution in the amount of carbon dioxide in the blood. Boise, on the other hand, regards Crile's experiments, together with those of Henderson and himself, as almost conclusive proof that the true pathology lies in cardiac spasm. He points out that the characteristic low arterial pressure is a manifestation of an over-stimulation of the entire sympathetic nervous system. Excessive systolic energy with deficient diastolic relaxations prevents a free return of blood from the veins, as a result of which the cardiac output is greatly decreased. More recently Janeway and Ewing[1] have contributed the results of their very elaborate experimentation. They take issue with both Crile and Henderson, denying absolutely that exhaustion of the nerve-centres is produced, and showing that as severe a degree of shock may be produced when provision is made for keeping the carbon-dioxide content of the blood high as when it is allowed to fall to 40 or 50 per cent of the normal. The all-important factor, in their opinion, in the development of shock is loss of vasomotor control, or, at least, the impossibility of regaining this control after it has reached a certain degree which determines the failure to recover. " The loss of control and its maintenance is never caused by acapnia or central nervous exhaustion, but, aside from afferent impulses, more especially splanchnic sensory impulses which may have initiated the shock and contributed to it, the loss of control was always due to local peripheral causes which in our work were mechanical obstruction, loss of blood, and trauma of the viscera.

" The practical conclusions from these observations emphasize the necessity, in attempting to prevent shock, of providing against a fall of blood-pressure and local trauma, particularly within the abdomen, as the most important of all precautions."

The *symptoms* of shock intervene at once, or soon after the operation, the patient's condition never having been satisfactory. She remains unconscious and becomes cold, pale, and relaxed. The reflexes are absent and she lies on her back listlessly. It may be difficult to arouse her. The face is white and pinched, the mucous membranes and finger-nails take on a bluish tinge. The respirations are rapid and irregular or may be extremely superficial. The temperature is low and may be subnormal. The pulse is most characteristic, being small and feeble, but revealing the arterial cord. It is more often rapid but may be slow. Vomiting, of course, may be present but it is never due to shock. Occasionally delirium may be observed.

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[1] H. H. Janeway and E. M. Ewing, *Annals of Surgery*, 1914, vol. lix. p. 159.

Where shock comes on a few hours after operation its onset is sudden and it is then most difficult to differentiate from post-operative haemorrhage. Where treatment avails, the condition slowly disappears with reaction, the temperature, pulse, and respiration becoming more nearly normal, consciousness returning, and the reflexes giving response. If treatment is ineffectual, the general condition becomes speedily worse and the patient sinks into a stupor indicative of approaching death.

One of the most difficult problems in post-operative management is the distinction between shock and haemorrhage. The physiology of shock and of acute anaemia are not the same, but the clinical evidences are very much alike and the treatment is similar. In active haemorrhage, however, no greater error could be made than to treat as for shock. The differentiation, therefore, is most important and may be outlined as follows :

SHOCK	HAEMORRHAGE
1. After prolonged operations, especially if loss of blood or much trauma.	1. Irrespective of length or character of operation.
2. More apt to occur in patients who have been acutely ill, or who are weak and exhausted.	2. Irrespective of previous condition of patient.
3. Signs date from operation, collapse coming on suddenly where general conditions and pulse have not been satisfactory.	3. Signs develop gradually some hours after operation, patient having recovered from anaesthetic.
4. Signs tend to get better.	4. Signs tend to get worse.
5. Patient is relaxed and apathetic, lying quietly on her back.	5. Patient is restless, tossing her head and arms, and is anxious and worried.
6. No abdominal pain ; abdomen soft.	6. Abdominal pain, may be severe ; abdomen tender and may be rigid.
7. Skin is blanched, cold, and clammy.	7. Skin is very pale, cold, and clammy.
8. Face is pallid and pinched.	8. Face is white and pinched.
9. Mucous membranes blanched.	9. Mucous membranes blanched.

10. Finger-nails bluish and may be squeezed into a blush.	10. Finger-nails livid and cannot be squeezed into a blush.
11. Eyes closed, reflex absent.	11. Eyes staring and glassy, pupils dilated.
12. Recurrence of syncope seldom.	12. Recurrent attacks of syncope frequent.
13. Temperature low, may be subnormal.	13. Temperature usually subnormal.
14. Pulse small and weak, usually rapid, but artery is full.	14. Pulse weak and thready, nearly always rapid, arterial cord not palpable.
15. Respiration rapid and shallow.	15. Respiration laboured, deep, and gasping.
16. No complaint of faintness.	16. Faintness and ringing in the ears.
17. No complaint of thirst.	17. Thirst.
18. Superficial veins full of blood (noted in transfusion).	18. Superficial veins collapsed.
19. Blood finding negative, haemoglobin not changed.	19. Moderate leucocytosis, with sudden decrease in percentage of haemoglobin and in number of red cells. Increased coagulability of blood.
20. General stimulating treatment improves the pulse.	20. General stimulating treatment alone of no avail and may increase haemorrhage.

The longer reaction is delayed after collapse the worse the prognosis. As a rule symptoms improve slowly but steadily, and after a few hours the patient is no longer in danger. Where reaction is delayed over twelve hours the prognosis is not good. Severe vomiting before reaction tends to retard or prevent recovery. Delirium intervening is a bad sign and, if accompanied by a persistently low temperature and rapid pulse, recovery is improbable.

Having in mind the known factors that produce shock, whether we agree as to its nature or not, its prophylaxis need not be considered here at length as it has been dealt with in the Article on Operative Technique (p. 283). To shorten the duration of operation, to prevent unnecessary escape of blood, and to avoid undue handling of viscera or traumatizing of tissues have long been three of the cardinal principles of modern surgery. They constitute important details in operative technique and are more adequately discussed in the chapters devoted to that phase of this work. As to Crile's anoci-association methods, now so well understood throughout the surgical world, they comprise a definite advance in this field. Whether or not shock is an expression of nerve-centre exhaustion, nerve blocking and all the elaborate minutiae of surgical manipulation comprised in anoci-association must be accepted as of the greatest importance in the progress of operative technique. By no means the least valuable factor in this method is Crile's advocacy of nitrous oxide in anaesthesia. Unless administered with greatest care, ether produces a marked reduction in blood-pressure, yielding advantage in this respect to nitrous oxide gas which is also less toxic.

In the *treatment* of shock energetic measures must be undertaken without delay. The three essentials are: first, to keep the patient warm; second, to keep the heart going; and third, to fill up the circulation.

The foot of the bed should be raised 15 or 20 inches and the patient wrapped in hot blankets, with hot-water bags placed about the trunk and lower extremities. A hypodermatic injection of strychnia (gr. $\frac{1}{20}$) and nitroglycerin (gr. $\frac{1}{100}$) is next given. Meantime normal salt solution is prepared, and one pint, together with an ounce of brandy, is placed in the rectum. Strychnia in $\frac{1}{20}$-grain doses is continued every hour until the patient is better, and the nitroglycerin, with atropin (gr. $\frac{1}{150}$), is injected every four hours. Every two to four hours, according to conditions, the rectal saline, without brandy, should be repeated. Oxygen gas is advisable especially where the respirations are faint.

If much blood was lost during the operation, a pint of saline solution should be injected into one of the veins of the forearm in the first instance. The rectal enema, however, can be prepared and administered more speedily and is usually given first. Subsequently, saline by hypodermocleisis, preferably under the breast, is the method of choice. But where the patient eventually does not rally, or improves very slowly, venous transfusion should be resorted to. After the patient has shown definite power of resorption, stimulating rectal enemata of coffee or beef tea, with or without brandy, will be sufficient until food may be given safely by the mouth.

Hypodermatic injections should never be given in the arms or legs, where the circulation is too poor to make speedy resorption possible. These injections should be placed deeply in the tissues of the chest or abdomen. After the patient's head is lowered, her legs may be tightly bandaged from the ankles upward, exactly as in the case of acute anaemia. Digitalin (gr. $\frac{1}{50}$) every two hours is advised by some clinicians, but is not well indicated in shock where it raises the blood-pressure without benefiting the action of the heart. Likewise the increased resistance of vaso-constrictants, such as adrenalin and pituitrin, might be positively dangerous to the heart in shock, yet these preparations are strongly recommended. Thus Stevens uses pituitrin and advises against strychnia, preferring the ergotin preparations if pituitrin is not obtainable.

During the past few years the writer has had occasion to care for a certain proportion of his surgical cases at a hydro-therapeutic institution where the marked success in post-surgical treatment has repeatedly attracted his attention. At this institution the after-care is carried out as follows:

Immediately upon returning from the operating room the patient is given alternate hot and cold applications to the chest, with a hot pack around the limbs as far as the hips at the same time. The heat to the chest is applied with hot fomentations which are left on the chest from two to three minutes, and then a compress wrung out of ice-cold water is placed on the chest for a second. This is followed by another hot fomentation and again cold application. This is repeated at least four or five times.

The hot pack to the limbs is given as follows : A dry blanket is placed around the legs and a wet hot blanket outside of this, then a dry blanket on the outside. This is left on about eight or ten minutes, great care being taken not to burn the patient. Following the heat and cold to the chest a cold mitten friction is given to the chest. A mitten made of heavy mohair is dipped in ice-cold water and the chest and arms are rubbed with this. Then a dry chest pack, which has been laid on the bed previous to the patient's being placed on it, is wrapped around the patient's chest and the arms are protected with sleevelets. The leg pack is now removed and the legs are given a cold mitten friction and thoroughly dried and long surgical flannelette stockings are placed on the limbs. Just before the leg pack is applied the patient is given an enema, one pint, temperature 100° to 110° F. This treatment is repeated every four to six hours, depending upon the condition of the patient during the first thirty-six to forty-eight hours following the operation.

For surgical shock, either partial or profound, the treatment is as follows : The heat and cold previously mentioned to the chest and particularly over the heart is applied for some length of time, until the heart seems steadier in its action and its beat more forcible. The heat and cold given at such a time must be vigorous, very hot and very cold, and applied alternately in rapid succession. Rapid percussion is used on the chest particularly when the cold is applied. A hot enema of one pint to a quart of water, temperature 110° to 115° F., is given. After this the Murphy drop method of normal saline or simply tap water, temperature 100° F., is used. A hot pack to the legs is given, but this is continued long enough only to warm the patient. In severe shock the patient is put in the Trendelenberg position and the abdominal pressure is increased. Hot and cold friction to the skin is used. The nurse puts on a heavy rubber glove and a sponge or friction mitt is dipped into a bucket of very hot water and applied quickly to the skin of the arms, chest, and limbs in succession. Immediately following the hot the mitten immersed in ice-cold water is applied. This is alternated two or three times. Heat and cold are applied to the spine as follows : a hot fomentation is placed the whole length of the spine and covering a large portion of the back, then a Turkish towel wrung out of cold water is applied to the spine. This treatment is given alternately and in rapid succession, the same as the heat and cold to the chest.

Digitalin, strychnia, or camphorated-oil may be given in association with this treatment, but they are seldom necessary. Much quicker and more certain results are obtained with the treatment described. For the past eight years, with an average of three heavy surgical operations a week, no cases of post-surgical pneumonia nor deaths from shock have occurred.

As soon as reaction is well along the patient may be fed cautiously on small amounts of concentrated liquid foods. She must be kept very quiet and nursed guardedly. Gradually the bed is lowered. Prolonged convalescence need not necessarily follow, as recovery is usually rapid after the condition is once passed.

Haemorrhage

Secondary haemorrhage has become a rare complication with the perfected technique of modern surgery. It is due in practically every case to the slipping of a pedicle ligature or of the ligature of a tied vessel. A slow constant oozing, however, may continue long enough to produce acute anaemia, as where an intraligamentous fibroid has been shelled out leaving an oozing cavity, or where the extirpation of an abdominal tumour has left extensive raw surfaces of the intestinal tract or on the parietal peritoneum.

The classical *symptoms* of post-operative haemorrhage have been set forth in the paragraphs devoted to shock. They come on gradually, usually within six hours and rarely as late as twelve after operation. There is a rapid weakening of the pulse which becomes thready, and the artery is scarcely palpable. The superficial veins are flat. The patient may have recovered from the anaesthetic but now becomes restless and anxious. She is thirsty, has disturbance of vision, and shows evidence of air hunger in the laboured, gasping respiration. She complains of pain in the abdomen, and there is local tenderness with dulness in the flanks. The condition progresses rapidly into an acute anaemia, and, in the severer cases, delirium or convulsions may precede death. Where the haemorrhage is oozing in character the course is much slower, the symptoms being modified. In such a case the greater difficulty lies in the differentiation from shock. In drainage cases, red blood or serum may escape freely from the wound.

The *prognosis* is grave until the bleeding point is tied. It depends upon the preoperative condition of the patient, upon the amount of blood lost during the operation, and upon the present degree of haemorrhage. Where anaemia has become marked, recovery will be slow and several months required before the patient is again normal.

In such cases, too, infection is a complication to be feared. Where the vitality is lowered by loss of blood the patient may yield to a degree of sepsis that would otherwise be readily combated. Post-operative haemorrhage, therefore, in suppurative peritonitis is of extremely grave import.

Prophylaxis, again, becomes a technical part of operative surgery. Suffice it to say here that too much care cannot be exercised in the placing of ligatures, and that important ligatures, those enclosing known vessels, should always be passed through the tissues by needle or better by ligature carrier. The stump should be cut long enough so that it will spread out above the knot. Again, the surgeon must constantly keep watch over his assistants to see that the ligating material is not cut too close to the knot. As an added safeguard, it has become the writer's habit to tie all ligatures with three knots instead of two. Finally, in peritonization, as in burying a row of ligatures under folds of peritoneum, the ultimate precaution is taken. This compels a close inspection of the stumps and buries them snugly so that a moderate oozing would be stopped.

Treatment.—Secondary haemorrhage demands active treatment without delay. There are those who speak of a light internal haemorrhage which is treated by elevating the pelvis, keeping the patient quiet, and stopping all stimulants for twenty-four hours. Few men of experience, however, will prefer to accept such a chance. Since the days of Ambrose Paré the only treatment for a bleeding vessel is to ligate it. This requires that the abdomen be reopened, the bleeding point found and tied, and such measures undertaken for restoring the patient as conditions justify. All of these things should be done without delay. The abdomen will not need to be prepared again and only sufficient blood should be removed to expose the point of haemorrhage. Naturally the points of ligation will be first inspected and here the haemorrhage will usually be found. After stopping the escape of blood the peritoneum may be sponged clean and the wound closed at once. The patient should be kept warm on the table and the legs may have been bandaged already. After the haemorrhage is checked the head is lowered, or this may be done before if the Trendelenberg position is necessary for exposure.

The anaesthetic need be but very light for this purpose. Indeed, where the patient has not fully recovered from her anaesthetic, or where she still shows the influence of her pre-operative morphine, a very little nitrous oxide is altogether sufficient. Chloroform should never be given in secondary haemorrhage.

It is obvious that stimulants, and especially normal saline solution, should be omitted before the haemorrhage is checked. No greater error could be committed than to fill the venous side while the arterial is leaking. Where the bleeding has been very severe, haemorrhage may have stopped spontaneously, and in this case no bleeding point will be evident. Here a slipped ligature should be looked for. Meantime an assistant administers the saline intravenously and, as the blood-pressure rises, the point of haemorrhage comes into view and may be securely ligated.

While the patient is still on the table, cardiac stimulants are given hypodermatically—strychnia, nitroglycerin, and atropin. To replace the volume of blood lost, however, is most important of all. This is done by the free injection of salt solution. The speediest method, perhaps, is to leave the abdominal cavity full of saline solution before closing up, supplementing this later by rectal administration of the saline and brandy. Where the patient's condition is grave, an assistant may employ venous infusion while the operator is engaged in the wound, as has been suggested. The use of the saline under the breasts, however, is sufficient where conditions are not so desperate.

Where the haemorrhage is found to be due to profuse oozing from extensive denuded areas, the cavity should be cleansed and firmly packed with a long gauze roller, the end of which is brought out through the wound about a glass drainage tube.

As soon as possible the patient is hurried back to bed, where she is wrapped in warm blankets. The foot of the bed is raised and hot-water bags are placed around her. After-treatment consists in a repetition of the cardiac stimulants and of the salt solution, together with, as soon as it can be retained, highly concentrated liquid nourishment. As a rule six ounces of salt solution *per rectum* every four hours is sufficient for the next two days. Only rarely will infusion beneath the skin be required subsequently. Strychnia (gr. $\frac{1}{20}$) may be given every two hours for a time, the doses being gradually decreased and more widely separated as conditions warrant. Atropin and nitroglycerin are also to be repeated according to indications. Egg-white, beef-tea, meat-juice, and grape alcohol are the foods of greatest value immediately. The convalescence is apt to be prolonged, and the patient will then have to be kept on a rich, nutritious diet for some months before recovery is complete.

Following vaginal operations, haemorrhage may ensue for reasons as stated above. Thus after vaginal hysterectomy a ligature may slip. Here the haemorrhage will be through the vaginal tube and hence external. It may, however, be very severe before recognized. After simple plastic work, haemorrhage is less apt to be seen, except rarely after amputation of the cervix. Here it is due rather to failure to perfect haemostasis, the cut edge of the vaginal wall tending to bleed readily in certain cases. Further, while traction is made from below, thus holding down the uterus, haemorrhage does not occur when the stitches are introduced. After the uterus is allowed to relax, its arteries are relieved from tension and may bleed quite freely. For such work the over-and-over suture is preferable, as a haemostat, to the single through-and-through interrupted one. Nothing is more annoying in the after-care of the patient than to find active bleeding from the vagina. A tight gauze tampon left in twenty-four hours may be sufficient to check it, otherwise ligation becomes necessary.

Peritonitis

For purposes of description peritonitis may be divided into three varieties: (1) plastic, (2) diffuse suppurative, and (3) localized.

1. **Plastic Peritonitis** is also called *traumatic* or *adhesive*. Every operation involving the organs within the peritoneal cavity is followed by a reaction on the part of the peritoneum whereby the wounds are healed and ligatures encapsulated and absorbed. It is therefore a regenerative process and not to be regarded as an untoward complication. Not being indicative of infection, the rise of temperature is ascribed to the resorption of fibrin-ferment and other products of tissue-metabolism. Its extent and severity naturally depend directly upon the amount of exposure to the intestines and the degree of trauma produced. The lymph-exudate poured out produces adhesions between the various peritoneal folds, especially in the region of the traumatized areas. These adhesions in turn become absorbed later, or in severer cases they may remain permanently.

The condition is characterized by post-operative fever which comes on within ten hours and rarely rises more than 1½ or 2 degrees above normal. The pulse is correspondingly increased but remains soft and full. The abdomen usually is slightly rigid below, but soft above, the umbilicus, and local pain and tenderness are present. The patient complains somewhat of gas-pains but tympany is not marked. On the second day the symptoms subside, and by the end of the third should have disappeared. At no time is there any considerable increase in the leucocyte-count.

Occasionally these symptoms are more severe, with a somewhat higher temperature (102° F.), though the general condition of the patient is good and not in proportion to the complaint. Here the suffering is due rather to persistent nausea and vomiting, and to intestinal distension, than to peritonitis. Where there has been much, or rough, handling of the intestines greater distress is to be anticipated. In such cases, where the intestines are quiet after operation, post-operative adhesions are all the more likely to become permanent.

Where evidences of septic infection are not present after seventy-two hours, the patient will go on into satisfactory convalescence. The aseptic character of the operation and the generally good condition of the patient aid in differentiating from suppurative peritonitis during the first three days.

The *treatment* lies in the post-operative management already outlined in discussing emesis and purgation; in a phrase, early catharsis, and hot water given frequently in small doses by the mouth. A turpentine stupe on the abdomen and high colonic flushings will relieve the tympany, all food being withheld until the stomach is quiet. Eventually gastric lavage above and enemata below may be indicated.

2. Diffuse Peritonitis.—This form of post-operative peritonitis is due to the entrance of infective micro-organisms into the abdominal cavity. This takes place at the time of the operation, when the organisms are most apt to be streptococci or staphylococci; or infection may occur later, when the *bacillus coli communis* is, as a rule, the infective agent. The three chief factors making such infection possible are: (1) some flaw in aseptic technique; (2) imperfect peritoneal toilet with consequent oozing and the formation of haematomata; (3) extensive tissue-trauma, especially if the vascular supply has been seriously interfered with.

Flaws in aseptic technique are the imperfect sterilization of instruments, suture material, or sponges, or the soiling of these after being prepared; unclean hands of the operator or his assistants, or flecks of sputum from their mouths; imperfect preparation of the skin of the abdominal wall, or the vaginal mucosa; the escape of pus or faecal material during the operation. Imperfect asepsis is the most frequent cause of general peritonitis.

It long has been recognized that haematoceles occurring after operation are often followed by signs of peritonitis, the staphylococcus being more commonly the infective agent.

Where badly damaged tissues have been left, especially if exposed to the general abdominal contents and coming into close apposition with the intestine, colon-bacillus invasion is almost to be expected. This is particularly apt to be the case where there is partial venous stasis.

The *symptoms* of diffuse peritonitis are usually continuous with those of the adhesive variety, appearing not later than seventy-two hours. The patient's general condition may be good, though she may not have recovered fully from the anaesthetic, and the temperature is regarded as the conventional post-operative rise. During the second or third day, instead of falling, the pulse rate gradually increases in frequency until it reaches 120 or higher. It is quick, small, and tense, later becoming very weak and thready, finally imperceptible. The temperature is above normal from the first and rises steadily to 104° F. or above. A sharp rise on the second day is serious. Before the anaesthetic emesis has ceased, gastric irritability from the infection itself is present and vomiting becomes aggravated. This is at first small in amount but soon takes on a dark-brown or green colour and becomes much more profuse. Nausea, however, is not so marked as in irritative emesis. Sharp recurrent pains in the lower abdomen are at first complained of and these later become very intense. Meantime, tympanites appears as a result of the intestinal paralysis, and the abdomen becomes distended, the wall being markedly rigid. As a result, respiration is limited, being altogether thoracic and very rapid. Marked intestinal stasis is characteristic, the bowels not responding to colonic flushings. Restlessness and inability to sleep are the rule. The leucocyte-count shows a very rapid jump, going to 40,000 or more in a relatively short period of time.

As the condition grows progressively worse the pulse becomes weak and thready, the temperature rises to 105° F., and just before death may reach 106° F. or 107° F. The abdominal distension increases and the pain is agonizing. Enemata return clear. Retching and vomiting are intense, the gastric contents becoming faecal in character as reverse peristalsis takes place. Restlessness increases, the face taking on an anxious, pinched expression. The skin is cold and clammy, and delirium and coma intervene shortly before death. Leucocytosis shows a rapid decline, and the urine will be abundantly full of albumen and casts.

A so-called ‘ septic peritonitis ’ is a form characterized from the start by these more marked symptoms. It represents a virulent streptococcic infection and is seen more often in patients whose vitality is lowered. The patient is exceedingly ill within a few hours after operation, showing marked depression. The pulse is very rapid and the temperature variable, ranging from 99° to 105° F., or it may be subnormal. Distension may not be marked, the abdominal wall being rather hard and spastic. The patient is in collapse and relatively free from pain. As evidence of her lowered resistance the blood-count shows no increase in the leucocytes, the polynuclear cells being especially wanting. All curative measures seem to be of no avail, and death ensues in two or three days. This form of peritonitis requires differentiation from both shock and internal haemorrhage.

With modern methods of treatment the prognosis has changed for the better. Most patients succumb or recover during the first week, but they may survive longer according to the virulence of the infection or the resisting power of the individual. Peritonitis is therefore always regarded as an extremely grave post-operative complication.

Prophylaxis again includes all those points of detail which go to make up the preoperative management of the case and the technique of the operation itself. There are a few such points, however, which can bear emphasis and which are not regarded as of sufficient importance in the average hospital.

1. It should be an essential that the operator and his assistant never handle or dress pus-cases at any time, a special house physician being employed for this purpose. If allowed to assist in operation, this assistant should never introduce his hand into the wound nor should he prepare the abdomen for the section.

2. The assistant caring for infected cases should never be allowed to dress a clean case.

3. Nurses caring for infected cases should not perform the same duties for clean cases. This may seem over-cautious at first, but it is evident that a nurse handling a bed-pan for a woman with a discharging pelvic abscess should not wait on a woman with an uninfected perineal or cervical wound. Neither should the same nurse catheterize both patients.

4. Therefore, clean cases and infected cases should not occupy adjacent beds in the same ward. It were far better, indeed, to have separate wards for the two types, for it is only in keeping with modern sanitary ideas that all infectious or contagious patients should be isolated. This would make it impossible to use the same dressing-room for both clean and unclean cases. The advantage of the private patient in a private room under the care of a private nurse over ward patients in the average hospital where such rules are not in force must be apparent to all.

Treatment.—In the treatment of diffuse peritonitis there are four things to do, but unless these procedures are undertaken early they are useless, for the patient, later on, dies or gets well without them. This fact emphasizes the importance of an early recognition of the condition of the peritoneum. No one method, nor all methods put together, will avail if the patient is moribund before the nature of the complication is diagnosed. For the present we have no ready means of measuring either the virulence of the infection or the patient's resistance. Empirically we know that where diffuse peritonitis has occurred, the earlier it is treated the greater is the chance of recovery. These four procedures, then, in the order of their performance are :

1. *Drainage.*—First of all it should be stated that abdominal or vaginal drainage is debatable. At least, either method is not generally accepted, certain clinicians of experience refusing to believe in its efficacy. Thus Herman, of London, in agreement with German opinion regarded reopening the abdomen in the absence of localization as a method, merely, of shortening the patient's suffering. Vaginal drainage, in the absence of pelvic involvement with free exudate or pus, is of little or no value, as even a moderate experience in gynaecological surgery will prove. A gauze or tube drain in the pouch of Douglas will drain nothing where agglutinated coils of

intestines occupy the pelvic inlet, for such coils, held together even lightly by lymph-exudate, are virtually leakage proof, and permit no abdominal fluid to drain away. Abdominal drainage, on the other hand, is a very different matter, and is indicated post-operatively, as it is in generalized peritonitis due to other causes. Certainly it is not indicated in every case, but just as certainly it is of efficient service when indicated, and its application need not mean the execution of the patient. Under a light nitrous oxide narcosis or, better, with novocain injected interdermally, the lower angle of the wound, just above the symphysis, is quickly reopened, and a drain is gently introduced between the uterus and rectum into the pelvic cavity. This drain should be a good-sized one, either a rubber tube closely fenestrated, or the so-called cigarette gauze enclosed in gutta-percha tissue. Some surgeons prefer here the glass tube from which fluid may be aspirated, as in other types of peritonitis. Irrigation at this time should never be attempted, and chloroform should never be the anaesthetic of choice.[1]

2. *Fowler's Position.*—As soon as drainage is established, the patient is returned to bed, and elevated at an angle of forty-five degrees. This is best done by raising the head of the bed, mattress and all, and keeping it in that position either by a chair or by any one of the various apparatuses that have been devised for the purpose. To keep the patient from constantly slipping down, a board buttocks-rest, well padded, is fixed transversely across the bed, just below the buttocks, against which the patient rests with the legs flexed.

3. *Enteroclysis.*—This consists in allowing normal saline solution at a temperature of 100° F. to flow into the rectum in large quantities. The flow may be continuous or interrupted. If the continuous method is employed, the irrigator is hung low, not more than six inches above the hips, so that too great pressure be not exerted. The fluid must be kept at as nearly a constant temperature as possible. The rectal tube must be bent, since a straight tube would injure the posterior rectal wall with the patient elevated. The escape of gas from the anus must not be inhibited. By this method from eighteen to fourteen ounces will be absorbed every hour, depending on the needs of the individual case.[2]

Owing to the many technical difficulties in administering salt solution continuously, the interrupted method is employed by many operators. With the patient on her back, or preferably on the left side, a thirty-inch colon-tube is passed carefully. The gas is first allowed to escape, after which six ounces of saline solution is made to flow slowly into the sigmoid or above it. The tube is then withdrawn. This small quantity of fluid is readily retained and may be repeated as often as once hourly without much irritation. In moderate cases six ounces every four hours is enough. This method has the advantage of making it easy to add an ounce of brandy as often as required. In the experience of the writer the interrupted modification of enteroclysis as devised by Murphy has proved very satisfactory.

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[1] The question of drainage is also discussed in the Article on Technique (p. 352).—EDITORS.

[2] See also Article on the Vermiform Appendix (p. 108).—EDITORS.

As an alternative to enteroclysis, some authors continue to describe the instillation of fluids into the body by subcutaneous injection. The value of this method of introducing water into the body is not to be disputed, but its greater technical difficulties, especially where continuous absorption is desired, make colonic ingestion the method of choice in nearly every clinic.

4. *Stimulants.*—In addition to the stimulation afforded by the normal saline solution, brandy and strychnia are given. The brandy should always be included in the retention enemata as the stomach will rarely retain it. Strychnia is given by hypodermatic injection as an aid to the heart. Stimulation of the kidney is assisted by spartein in large doses. The objection to strychnia and alcohol on the part of some operators is not without foundation. In very severe cases these drugs do not appear to be of much advantage, as, indeed, no other method of treatment does. After all, when the patient has been placed in the Fowler position and is absorbing salt solution to the full extent of her capacity, by far the best opportunity has been offered her for recovery.

It is regrettable, indeed, that specific treatment of so grave a complication has not been perfected in the employment of sera or vaccines. A few years ago great hopes were placed in these, but thus far they have proved disappointing. More recent knowledge as to bacterial mutation explains this in large part. Where a case appears clinically to be a purely streptococcus infection, a polyvalent serum may be used, but it must come early in the course of the infection. Autogenous vaccines are of much greater value, but the time required for their preparation, two or three days, is a serious obstacle. Stock vaccines, especially if mixed, may be tried while the other is being got ready. Serums and vaccines will at least do the patient no harm.

Other measures aiding in recovery are employed according to symptoms. An ice-coil is kept on the abdomen. In case of marked tympany a turpentine stupe may be substituted from time to time. Eserin sulphate is also well indicated in distension, though pituitrin is preferred by some surgeons. Morphine or heroin will be required in doses sufficient to modify pain. Gastric lavage is most efficient in relieving nausea and vomiting, though in desperate cases this procedure is not well tolerated. It is absolutely essential, however, where dilatation of the stomach coexists. A close watch must be kept on the kidneys and if acidosis develops a glucose solution is to be used. Cool or tepid sponge baths, according to the toleration of the patient, should be ordered in all cases where the temperature persists over 103° F. As soon as the stomach becomes quiet, drugs for catharsis, and liquid foods may be given. Retention and nutrient enemata may then be stopped and colonic flushings for evacuation be started.

3. Localized Peritonitis.—In this form of infection the same etiological factors may be found as in diffuse peritonitis. It more commonly follows, however, operations involving infected tissues, as, for instance, the enucleation of pus-tubes. The infected area tends to remain limited by its walls of inflammatory exudate but, under pressure, rupture may ensue giving rise to general peritoneal involvement. It also frequently follows the infection of a pedicle, or of its ligature, or of a line of suture. Finally it may be secondary to suppuration in the abdominal, or in the vaginal wound. There may of course be more than one focus of infection.

The symptoms come on usually between the fourth and sixth days or they may be delayed until the end of the first week. The patient's condition has been good, when there occurs a rather sudden rise in pulse, temperature, and leucocyte-count. The pulse rarely goes over 120, and the temperature tends to fluctuate between 100° and 103° F. Very soon after this rise is noticed she complains of pain which she is able to localize fairly definitely. The abdomen will be found to be moderately distended and tenderness exists in the region of the pain. The pulse remains strong and full, and the patient is not very sick. Only rarely, when the infection is most virulent, or where her vitality is considerably decreased, will the symptoms become so marked as to resemble general suppuration. Where such factors do obtain, indeed, the case very soon becomes one of diffuse peritonitis. Pyaemia may also be a secondary development.

A slow course is the rule, with no tendency towards collapse so long as the infection remains a local one. The bowels are difficult to keep open, and great pain may be experienced upon evacuation or even upon passing the rectal tube. Tympany increases and eventually a swelling is felt in the lower abdomen, or in the pelvis, by vaginal touch. The symptoms come to be those of partial intestinal obstruction, with nausea, vomiting, and sharp colicky pain. If untreated the condition goes on to general peritonitis, as has been suggested, or is relieved by spontaneous discharge of pus through the abdominal or vaginal wound. In rare instances a chronic abscess may persist in the pelvis.

Local suppuration must be distinguished, therefore, from the other two forms of peritonitis, and is based largely on the appearance of a swelling in the pelvis or near the line of abdominal incision.

As a rule these cases recover eventually, though convalescence may be much prolonged. Absorption from retained suppurative material keeps the patient's vitality lowered. Recovery is usually speedy following prompt treatment.

This consists in locating the focus of infection and in evacuating the abscess. Opening the lower end of the wound and inserting a drainage tube may be sufficient. It may appear wiser, however, to drain laterally, in which case a stab-wound is made for the tube, after which the old wound may be closed again. Frequently the swelling is found in the pelvis, as low, perhaps, as the *cul-de-sac* of Douglas. Evacuation then is best accomplished by an incision through the posterior vaginal fornix, as close as possible to the cervix in order to avoid the rectum. Drainage is then established by fixing a tube in place or by gauze. The technique of this procedure is in all respects the same as that of vaginal drainage under any circumstances, and has been fully described in another place (p. 352). Care must be taken that the opening does not close up too soon. The drains are left in for forty-eight hours, are then removed, and are replaced only if the amount of discharge seems to be considerable. It is particularly important in local infection to avoid irrigation of the abdomen or pelvis.

There is no point in gynaecological surgery where the operator must exercise greater caution than in determining whether, or not, a pelvic mass contains pus. If there is reasonable doubt, evacuation by posterior colpotomy should not be attempted, as injury to a possibly prolapsed and adherent loop of ileum or sigmoid flexure would almost certainly lead to intestinal obstruction.

The patient again is elevated into Fowler's position and hot fomentations are applied to the wound. If the discharge is *per vaginam* antiseptic douches will be necessary twice daily, and the ice-coil may be placed on the abdomen. The colon-tube and rectal enemata are used for the relief of gas-pains. Retention enemata of normal saline solution are given in a routine manner. Where the stomach is unable to retain food, these injections should be made up of nourishing liquids. The heart and kidneys will require stimulation. Active catharsis is particularly important as soon as the stomach is quiet enough. In a word, the treatment is identical with that of diffuse peritonitis, being modified only by the different conditions.

Pelvic Cellulitis

Inflammation of the cellular tissue of the lower portion of the broad ligament may follow any operation involving pelvic organs, but is oftenest discovered after the simpler procedures carried out by the vaginal route. Especially where the cervix has been lacerated in dilatation, or where stitches have become infected following high amputation of the cervix, is cellular infiltration apt to be seen, though any operation involving the broad ligament may lead to it. For a description of the clinical features and treatment of the condition, the special article on Pelvic Cellulitis should be consulted (see Vol. I. pp. 649-670).

Abdominal Wound-Infection

Infection of the abdominal wound is usually of little importance, being nearly always superficial. It may, however, be deep and, if the infecting agent proves virulent, result in very serious consequences. It is oftenest due to infection of the entire wound from septic tissues below, or from the skin-surface of the abdomen above. Less often the fault lies in imperfectly sterilized suture material or in technical carelessness at the time of the operation. Imperfect haemostasis, giving rise to subcutaneous haematomata which are easily infected, may be the factor. Again, in patients who are anaemic or debilitated, as in those suffering from carcinoma, the process of healing is less perfect and less resistance is offered to infection. All wounds require a certain amount of drainage for a few hours, which normally takes place between the interrupted sutures closing the skin. Where skin closure is too tight, therefore, serum or blood is unable to escape but forms a pool between the superficial and deeper suture lines, thus preventing primary union and forming an ideal culture medium for infective micro-organisms.

1. **Stitch-Abscess.**—This appears as a rule on the sixth or eighth day, though it may not occur until after the stitches have been removed, in which case infection is probably due to an unclean end of the suture being dragged through the track. The reaction is altogether local and is discovered at the first post-operative dressing. There may be a little pain and soreness in the wound, though often not enough to call attention to it. On the other hand more than one suture may be involved and, by the time discovered, a portion of the wound is undermined by an accumulation of pus which wells up through the stitch-holes, staining the dressings. In such case the local symptoms should be severe enough to call attention to the wound, and the temperature may rise to 100° F.

The possibility of stitch-abscess should be constantly borne in mind, and the slightest symptoms pointing towards it investigated. Early recognition and prompt treatment are necessary in order to keep it from extending into a general suppuration of the wound. Otherwise the condition is a trivial one responding readily to treatment, which consists in removing the stitch thus allowing freer drainage. When two or three adjacent sutures are involved, it will be best to separate slightly the edges of the wound and place between a small twist of gauze. A large compress of gauze is then placed over the wound and the bandage reapplied. Redress daily until all discharge has ceased.

2. **General Suppuration.**—When the entire abdominal wound becomes suppurative the abscess usually forms in the subcutaneous layer of fat and rises upwards towards the surface. On occasion, however, the interrupted stitches closing the upper layer of fascia become involved, in which case the entire wound will break down as far as to the peritoneum. Even here the tendency is to point upwards, and only very rarely has rupture occurred into the peritoneal cavity.

Symptoms of wound suppuration appear by the end of the first week or middle of the second. The temperature is irregular but higher than it should be at this stage of convalescence, varying from 99·5° to 103° F. The pulse is correspondingly accelerated. Discomfort in the wound is at first noticed; later it becomes acutely painful and very tender. On palpation the wound edges will be found indurated and fluctuant if abscess-formation has taken place. Pus may have escaped already on to the dressings.

When the suppuration has involved the fascial and muscular layers, the patient suddenly develops symptoms of septicaemia which continue progressively until the wound is drained. In case the abscess ruptures through the peritoneum, septic peritonitis is produced with violent reaction and speedy collapse.

A type of wound-infection peculiar to itself is that produced by the *bacillus aerogenes capsulatus*. Here the symptoms are much more severe and the patient grows steadily worse. Emphysema spreads rapidly through the abdominal wall and the wound becomes necrotic. The pain is great, the temperature persistently high, and the prognosis grave. Fortunately the condition is rare.

The integrity of the wound is not impaired where suppuration is limited to the subcutaneous space, whereas danger of subsequent hernia naturally ensues if the deeper lines of suture become involved. The length of the wound also is of some importance, as is the extent of lateral burrowing by the pus. As a rule these infections tend to disappear promptly when treated, the wound closing by granulation and cicatrization from below upwards. Naturally, too, the condition of the patient is a factor in the prognosis.

As has been intimated in discussing the etiology of wound-infection, a large part in preventing it lies in the technical detail of the operation, the minutiae of which have been discussed elsewhere. Suffice it, at this time, to mention briefly a few points that cannot be over-emphasized in abdominal wound closure: (1) Great care must be constantly exercised to keep the wound edges covered during the operation. This is best done by simply allowing the retractor blades to include the edges of the towels or sheet with which the abdominal wall is covered. Especially is this important where the wound edges are bruised or under prolonged tension as in long, difficult operations. (2) Similar care should be taken in removing infected material from the abdomen or pelvis, so that sponges are not rubbed against the gaping edges. (3) The wound should be prepared for closure at the time it is made, thus avoiding fresh bleeding just before closure. (4) Suturing in layers, generally accepted as the most reliable method, should be so done as to avoid leaving dead spaces for the accumulation of blood or serum. (5) All bleeding points must be secured as imperfect haemostasis provides culture media. (6) Non-absorbable suture material is to be avoided where it must be buried. (7) Subcuticular catgut closure is bad as it makes the skin wound too tight thus preventing drainage. (8) In thick abdominal walls, as in fat patients, suppuration is much more liable to occur. Greater care must be exercised to avoid dead spaces. An extra layer of catgut may be run through the subcutaneous fat, but skin-drainage by one or two small gauze wicks is preferable. (9) Michel's skin clips make a very beautiful closure, but too often are placed so close together as, again, to prevent drainage. They should be set apart at least three-eighths of an inch. (10) After closure is complete, the wound area should be cleansed with alcohol, dried, and the line of incision touched with tincture of iodine. The wound is then covered with a strip of gauze two inches wide and not over two or three layers thick. This is sealed at its outer edges with sterile collodion, particular care being taken to seal the lower angle. This is done to prevent infection being carried to the wound from the perineal-anal region when the patient flexes her limbs thus causing the other dressings to gape over the symphysis.

The *treatment* of wound-infection should be prompt and active. As soon as any local inflammation is suspected the dressings should be opened for inspection. If induration is present, the edges of the wound will be slightly raised and reddened. Two or three stitches are removed and a probe is passed for exploration, as at times suppuration has already occurred in the deeper structures. If no pus escapes, the wound should be left alone and the patient kept quiet. At the most, a hot-water bag may be laid over the dressings for the relief of pain, but hot wet dressings should not be applied as they cause the edges to separate. If pus wells up alongside the probe the edges of the wound at the lower angle should be separated as far down as necessary, thus allowing the broken-down material to escape, after which a small rubber tube is inserted as far under the suture-line as the probe has shown suppuration to extend. Often it is not necessary to remove all of the skin-sutures, drainage being below and above them. Where suppuration has been going on for some days, however, and the entire wound is undermined, usually it will open spontaneously throughout the greater portion of its length, or at least in two or three places. All of the stitches, except the through-and-through retention sutures, must then be removed, as free drainage is the essential in treatment. Many surgeons advise irrigation with various antiseptic solutions, but, except in the most severe forms of infection, this is of little value from a therapeutic point of view, being merely the method of cleansing the wound which is least painful to the patient. In most cases suppuration occurs just beneath the skin, and removal of stitches, followed by gauze drainage, compels the wound to close in from below very promptly. This is aided, too, by retaining the adhesive straps firmly in place, thus holding the edges of the wound close together. Redressing will be required every day, and the gauze must be diminished in size as the wound becomes more shallow. The raw edges may be touched lightly with tincture of iodine, or balsam of Peru, poured on freely, serves well to fill in the gaping spaces and to prevent further cellular disintegration. Where non-absorbable suture material has been used in closing the fascial layers, they must all be removed before suppuration will cease.

Where suppuration has been deep and extensive, the wound will gape in spite of retention strapping, and granulation tissue will then fill in the space in excess as pus-formation ceases. This may be touched with the silver nitrate stick from time to time. A more effective treatment, however, after the wound is again clean, is to curette away the granulation area, undercut, neatly trim the skin-edges, after which they may be evenly brought together again as in the original closure. This requires a nitrous oxide narcosis, but results most satisfactorily, the scar closing as firmly and evenly as if the wound had never been infected.

Where the suppurative focus is limited to the subcutaneous tissue, the patient need not be kept in bed longer than the regular time demanded by her case. Only where the fascia and muscularis is involved will her period in bed be prolonged beyond the third week. Here the greatest subsequent danger is from herniation, and she will have to wear an efficient abdominal supporter for ten or twelve months.

In case of the more severe gas-bacillus infection, the patient must be treated along the lines of general septic infection as well as locally. The ragged, undermined edges of the wound must be cleansed and curetted thoroughly, and the cavity packed with gauze dressings saturated with some antiseptic possessing ease of penetration. One of the best is the formalin-glycerin solution already described. Another is a solution of silver nitrate (0·5 per cent). If the patient survives, the entire wound subsequently may have to be re-united from peritoneum out, and skin-grafting will be required where sloughing has been extensive and the abdominal wall is not sufficiently relaxed.

3. **Sinus-Tracts.**—Where non-absorbable suture or ligature material has been used in an operation, infection taking place will often persist for a long time with a more or less continuous discharge from the infective focus up through the wound. This, of course, is much more apt to occur where drainage has been employed in the first instance, the permanent ligature or suture becoming infected early. These tracts arise from either the fascial or the peritoneal lines of suture in the abdominal wall, or, as is more often the case, from pedicle ligatures in the pelvis. They tend to follow the old lines of drainage and to persist for months or years. While usually single, they may be multiple and may even intercommunicate somewhere along their course.

The diagnosis is made by finding a sinus outlet in the line of the old wound or drainage outlet which tends to close and reopen from time to time, discharging a purulent or sero-purulent fluid. While the tract in many respects resembles a fistulous one, there is never an escape of faeces or urine. A probe will pass to the bottom of the sinus where a somewhat extensive cavity will be determined, or where other tracts lead off to other foci of infection.

Until the infected suture is spontaneously discharged or is removed by the surgeon, the sinus-tract will persist. As a rule spontaneous discharge is delayed for months, but does occur eventually, and rarely this will take place not through the skin but by way of the bladder or intestine, after which the tract closes without further delay. Fortunately this complication is much less frequent to-day, when suture materials are better prepared than formerly, and when absorbable material is more extensively employed. Two factors in preventing sinus-formation should be mentioned: first, where drainage is anticipated, non-absorbable material should be eliminated as much as possible from the pelvis and entirely from the abdominal wall; second, where permanent suture material is essential, as in certain operations for shortening the round ligaments or for fixation of the uterus, it should always be carefully buried beneath folds of peritoneum brought together with light catgut.

The *treatment* of such a complication consists in keeping the wound as clean as possible until the infected suture may be discharged or safely removed. In the more superficial variety the suture may be readily located by the probe, seized by a forceps, cut and removed. An instrument tipped like a crochet-needle will be of great service here. Where, however, it is difficult to find the suture, one should wait for spontaneous discharge. While tedious and annoying, the more superficial sinus-tracts cause no great amount of distress. Where the sinus leads into the peritoneal cavity, all the more patience is required. Little will be gained by probing or attempting to locate the offending suture. At times the free end of the suture will be carried upwards to the surface, whereupon it should be seized and pulled out or cut off as far down as possible. Ashton[1] has described a silkworm-gut snare which is passed down the sinus and twisted in the hope of entangling the infected ligature. At all events, expectant treatment is the established custom in these cases, the sinus-opening being kept clean and free from obstruction. Granulation tissue will require cauterization from time to time.

Eventually the woman's patience is exhausted, or the bottom of the tract fills up, demanding free drainage, and operation becomes necessary. Where this is extraperitoneal, an incision is made through the old scar, a probe being first passed down the sinus. The bottom of the tract being opened up, the suture in question is removed. The infective tract is then dissected out or curetted free from necrotic tissue, and the wound allowed to close in from below. A very little gauze packing may be necessary here for a day or two.

Where the sinus leads into the pelvis great care must be taken in opening along the tract in order to avoid injury to possibly adherent intestines or in reopening a closed intestinal fistula. With the probe in the sinus, the peritoneum is cautiously opened, the coils of intestines are freed as much as necessary, and the bottom of the sinus located by the finger. The infected ligature is exposed and removed. A cigarette drain is inserted for the purpose of isolating the sinus-tract and protecting the peritoneum, and the wound is closed. The drain should be discontinued after forty-eight hours. This operation should be deferred as a *ressort dernier* because of the danger of general septic infection and of subsequent herniation.

Vaginal Wound-Infection

Wounds created in the course of vaginal operations are subject to the danger of infection, and this would seem much more liable to occur where the bladder and anus are in such close proximity. As a matter of fact, however, the advantage of free surface drainage is nowhere better shown than in plastic procedures involving the vaginal walls. These wounds, where properly cared for after operation, tend to heal readily and, for the most part, by first intention. Given proper preparation, sutures in the cervix or vaginal walls seldom break down. Occasionally the superficial stitches between the fourchette and anal margin will become infected.

It should go without saying that vaginal plastic operations should not be undertaken in the presence of an infectious uterine discharge. Likewise it were better to avoid such work during menstruation and early in the puerperium. A third factor which, in the opinion of the writer at least, is a safeguard against infection in perineorrhaphy, consists in constructing the new perineal body with buried sutures. The closure of mucous membrane and skin is then superficial, and infection here becomes much less dangerous to the integrity of the wound.

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[1] W. E. Ashton, *Practice of Gynaecology*, 1909.

The perineum should be inspected each day when giving the external douche after defaecation or urination. If a stitch is found to be infected, it is to be promptly removed, and antiseptic dressings applied as previously suggested in the after-care of vaginal wounds. This is usually sufficient. Where, however, the entire wound has broken down and is suppurating, the non-absorbable stitches must be removed to facilitate free drainage, after which the wet antiseptic dressings are employed until all discharge has ceased.

Bursting of the Wound

In the more recent years of perfected operative technique, bursting open of the abdominal wound has become a rare occurrence. Yet there are factors present which tend to induce this accident. The abdominal wall may be primarily weak, as in asthenia, or secondarily weakened, as in the diastasis and relaxation subsequent to prolonged or repeated distension due to large abdominal tumours, ascites, or many pregnancies. Again, the patient may be suffering from chronic bronchitis or emphysema, in which case a persistent cough becomes the factor. Severe, prolonged nausea, with its accompanying retching, may occasionally be sufficient to tear open the wound, or in very extreme tympany the same thing has happened. Finally, where the patient is cachectic, as in advanced malignancy, or where the wound has become infected through profuse drainage, there is much greater danger of loss of integrity.

As a rule the wound gives way suddenly, after a severe attack of coughing or retching. The opening may be partial, involving first the lower rows of sutures, leaving the skin united, or it may be complete, the whole depth of the wound separating. The protrusion from below commonly appears through a portion of the wound alone, though on occasion it forces the entire length to gape. Occasionally too, after no unusual local distress, removal of the dressings reveals the wound open, with coils of distended intestines bulging out.

The signs are those of sharp local pain with more or less collapse on the part of the patient. At times the first evidence is that of blood soaking the dressings later than post-operative oozing should justify. Increasing rapidity of pulse is characteristic. The intestinal coils appear dry at first with small lymph-patches. Later they become red, injected, and show definite peritonitis. By this time the temperature also has risen.

Closure of the abdominal wound in layers has done more than any other technical detail to prevent this accident. The wound is best prepared for closure at the time it is made. This preparation is particularly urged in those cases where the recti muscles are separated and the fascial layers attenuated. In such case, too, it is often best to carry the incision high enough for removal of the umbilicus, the weakest point in the abdominal wall. This method of closure is briefly described in the paragraphs devoted to ventral hernia (p. 773). Further precautions against bursting of the abdominal wound lie in efforts to prevent vomiting and coughing, and to build up the physical strength of the asthenic patient. Next to careful closure of the wound, however, the most important factor is the support provided by the adhesive straps over the dressings, and by the firm scultetus bandage over all.

When the wound is found to have burst open in spite of every precaution the treatment consists in closing it again at once, after having carefully cleansed the intestinal coils with sterile saline solution and replaced them. Internal irrigation is harmful and drainage usually unnecessary.

Faecal Fistula

Following abdominal or pelvic operations, faecal fistulae occur (1) where there has been injury to the intestinal coats from separating adhesions, (2) where a portion of the intestinal wall has become necrotic from contact with an inflammatory mass, and (3) where an injury has been repaired or anastomosis performed with subsequent leakage. The great majority of fistulae follow the enucleation of pus-tubes, especially if these are tuberculous in nature, in which case the adhesions are apt to be extremely dense and extensive. In enucleating the diseased masses the intestinal wall is more or less damaged, but not opened. Later the intact portions of the wall break down. Fistulae may be due rarely to inflammation of the abdominal wall, a coil of intestine having become adherent beneath and later necrotic. Here the small intestine is more commonly involved. Again, pressure necrosis due to the prolonged use of a glass drainage tube has been known to result in a fistula.

It is fortunate that the great majority of fistulae are those of the large intestine, since this variety yields more readily to treatment. This is particularly true where the fistula discharges *per vaginam*, in which case the rectum and sigmoid flexure are most commonly involved. The small intestine tends more readily to become adherent to the abdominal wound and an opening here is a much more serious affair. The contents being liquid and more irritating to the skin, spontaneous closure is delayed, and, if the upper portion of the intestine is involved, general emaciation of the patient increases the gravity of the situation.

The prevention of injury to the various intestinal coats has become, therefore, one of the chief technical desiderata on the part of the surgeon. In breaking up adhesions, great force and great haste are to be equally avoided. The adherent intestinal loop is to be separated from the pyosalpinx mass to be enucleated, rather than the mass from the intestine, *i.e.* the adhesions should be broken free at the expense of the pus-tube. The greatest care will be required in freeing entangled coils of gut one from the other. Here patience and a gentle firmness will well repay both patient and operator. In case damage has been unavoidable, too great care cannot be exercised in repairing the broken intestinal coats and in covering all raw surfaces by folds of peritoneum. In the more serious cases grafts of peritoneum or omentum will be of inestimable service. Where the integrity of the gut-lumen has been totally destroyed or even endangered by extensive infiltration and sloughing, lateral anastomosis, resecting the damaged portion, should be done at the time of the operation. Where extensive raw surfaces have been produced in the pelvis thorough peritonization is essential in preventing one of the chief factors leading towards faecal fistula. Finally, in closing the abdominal wound the peritoneal edges should be everted, thus adding one more technical detail in avoiding raw surfaces.

The *treatment* of faecal fistula consists in keeping the wound clean by frequent changes of the dressings. The skin should be protected from the irritating discharge by a zinc oxide paste freely applied around the opening. Spontaneous closure is the rule, where the large intestine is involved, and this may occur within a few days or may require a year. Where the fistula persists it may close to a very small opening on the surface, thus permitting abscess-formation beneath, which will require evacuation. Hence it often becomes necessary to irrigate the fistulous tract with some antiseptic solution. Normal salt solution, followed by hydrogen peroxide, is often efficient here, and under such irrigation the tract tends to close from beneath upwards.

As soon as the patient's condition permits, a permanent fistula should be closed, and in no case should they be allowed to remain longer than one year. Especially where the small intestine is involved will relief by radical operation become necessary. This consists in resection of the injured intestinal wall with end-to-end or lateral anastomosis, thus enucleating the entire infected tract. Other methods, such as lateral anastomosis without resection, merely short-circuiting the fistula, or colostomy above the fistula, are almost equally extensive procedures without the certainty of cure.[1]

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[1] This subject is further dealt with in the Article on Intestinal Complications (pp. 555-591).—EDITORS.

Intestinal Obstruction

Post-operative intestinal obstruction may be classified as (*a*) organic or mechanical, and (*b*) paralytic.

The mechanical variety is due to many conditions which follow the various intraperitoneal procedures, or which result from pathological conditions existing previous to the operation. These etiological factors may be formulated as follows :

1. Adhesion of the intestine to other structures. Here the intestinal coil itself may have been adherent to the pelvic inflammatory mass, requiring its separation and thus leaving it with a denuded area. This is only a too frequent complication in pyosalpingitis. On the other hand, an intact coil may become adherent to any raw surface, such as an uncovered pedicle, an omental stump, denuded areas of the pelvic or parietal peritoneum, and corresponding raw areas on other loops of gut. Again, the intestine may become adherent to the peritoneal line of closure in the abdominal incision, or to the edges of the vaginal wall following intraperitoneal procedures by the vaginal route, such as hysterotomy or uterine interposition between the bladder and vagina. Without question, intestinal obstruction is most often due to adhesions of the type here referred to. A lymph-exudate is poured out on the peritoneal surfaces as a result of the operative manipulation, and intestinal coils become more or less agglutinated to one another or to adjacent structures. Such adhesions are light, often cobweb in texture, and, where relatively normal relations are sustained, produce no symptoms. They may be regarded as the natural sequence of abdominal surgery and at worst give rise to colicky pains, or act as contributing factors in constipation. Even where adhesions are denser or more extensive, kinking or twisting of the intestinal lumen does not necessarily result. It is only where the intestine becomes fixed in some abnormal position, so that it is sharply kinked or twisted, that obstruction ensues. Hence it is that the *raw surface* becomes such an important factor, inasmuch as it gives rise to extremely dense and strong adhesions. Where the sigmoid flexure becomes prolapsed and adherent in the pouch of Douglas, rough from the extirpation of pus-tubes or of an incarcerated tumour, or where a coil of the ileum is likewise caught, the points of contact become so densely fixed that obstruction is virtually certain to follow.

The presence of a diffuse peritonitis only too readily complicates matters and renders the diagnosis obscure. Some of the worst cases the writer has seen have been accompanied by a general peritonitis where the small intestine was adherent to the anterior parietal peritoneum. In such case fatal termination should more properly be attributed to obstruction than to peritonitis.

2. Following intraperitoneal operations, bands may form, stretching from one structure to another, directly involving the intestine or permitting it to slip underneath and become strangulated. These bands may represent the lighter adhesions that have been subsequently stretched out, or they may be due to lymph-exudate poured out on the peritoneal surfaces during the stage of plastic peritonitis. In either case they are dangerous to the integrity of intestinal loops. Frequently, too, a similar effect is produced by the omentum becoming fixed at various points in the pelvis, as a result of which a loop of the sigmoid flexure or a smaller intestinal coil is entangled. Indeed, in extreme omental involvement the transverse colon has been pulled down into a position of decided ptosis. While these bands in themselves may often exist without producing obstruction, they form the basic defect. Existing directly after operation, when the gut-lumen becomes over-distended by flatulence and peristalsis is increased, the kink very readily forms and is then speedily fixed by adhesions. Again, strong bands are sometimes created artificially by the surgeon, as in certain types of round-ligament shortening, pillars being created between the *fundus uteri* and the anterior abdominal wall. Where such structures are close together, a loop of the ileum might readily pass through into the anterior *cul-de-sac*, become distended, then fixed and eventually strangulated. Adherence of the gall-bladder to the abdominal incision has likewise given rise to obstructive fixation.

3. Strangulation of an intestinal loop through some orifice is another method by which obstruction occurs. Thus a hole in the mesentery or one in the adherent omentum may provide the orifice. The intestine may be looped already by adhesions, or lateral anastomosis, without resection, has been practised. Also after complete hysterectomy, the vaginal wound has admitted a coil of intestine. Likewise the gut has been found to have slipped through between the edges of the peritoneum and fascia in the abdominal wound, or to have been caught by the suture in closure, and thus to have become obstructed. Such an accident would appear to be the result of imperfect or careless technique, yet such cases have been reported and proved at autopsy. In the same manner it is possible to include a portion of the bowel in a ligature. The sigmoid flexure may be so intimately adherent to a left tubo-ovarian mass, or a left-sided tumour may so distend the meso-sigmoid, that too great care cannot be exercised in passing the ligatures or placing the clamps. Again, the appendix is often involved in right tubal masses, and the caecum so drawn down on this side that a carelessly placed ligature would include a part of it.

4. Volvulus is rare as a factor in intestinal obstruction, yet it does occur. This

lesion may be produced by the revolution of a single coil about its mesentery or by the twisting together of two separate coils. A flatulent coil, or one loaded with faeces and hanging by a long mesentery, presents the most favourable condition for a twist. The sigmoid flexure is again the structure most commonly involved, though occasionally a loop of the small bowel may take part in the twist. The *appendices epiploicae* may be a factor in this particular form of obstruction, since they tend very readily to form adhesions. Thus anchored in the pelvis by a narrow pedicle, the bowel-loop rotates, becomes distended, and then strangulates.

The sequence of events in post-operative obstruction, as pointed out by Herman, consists in (1) the fixing of the bowel by adhesions in the kinked position ; (2) the stoppage of the onward movement ; (3) the production of ptomaines in the arrested bowel-contents ; (4) the poisoning of the patient and paralysis of the bowel by these ptomaines. Thus, from the pathological aspect organic obstruction eventually becomes paralytic, ending, as it were, where the latter begins. A full explanation of paretic obstruction, or paralytic ' ileus,' as yet has not been offered, though it is less common to-day than formerly. It is seen almost entirely after operations that are prolonged or that require extensive manipulation, and then, too, in the undernourished, muscularly asthenic type of patient. The paralysis is confined to some definite section of the intestine, usually the lower portion of the smaller gut, and is therefore a local rather than a general involvement.[1] It is in reality not an obstruction so much as an inability of the bowel to propel its contents onwards, a true stasis. This condition has been termed *aperistalsis*, a condition where the motor apparatus in the intestinal wall, the plexus of Auerbach, is not affected by a stimulus. Where the mesenteric plexus does respond to stimuli, peristalsis is produced, and this may be increased by added stimuli until spasmodic contractions of the intestinal musculature take place, called *dysperistalsis*. This is the usual condition obtaining during the first day or two after abdominal section, the stimuli being the various procedures undertaken in the preparation for operation and in the operation itself. Strong stimuli, especially if continued or prolonged, result in over-stimulation and dysperistalsis gives place to rest, resulting in exhaustion or paresis. Hence the intensity and duration of the abnormal stimulation of the intestinal motor centre determines the difference between the two conditions. A mild dysperistalsis, therefore, soon after operation may be regarded favourably, at least as evidence that there is no paresis, but it should not become accentuated nor persist. The influence of ptomaines produced in the arrested bowel-contents may be questioned, but they undoubtedly enter in as one of the factors. On the other hand, M'Lean[1] argues that absorption from the bowel in ileus is very much diminished or entirely absent, and that toxic products, not entering the blood-serum, cannot be brought into contact with the central nervous system. Hence death, at least, is not due to toxaemia, but rather to a depletion of the vascular and lymph systems causing a grave circulatory disturbance, especially cerebral.

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[1] A. Tietze, *Beitr. z. klin. Chir.*, 1914, vol. xci. No. 3, p. 578.

Signs and Symptoms.—The patient has been doing well for a day or two when vomiting recommences, or, if the anaesthetic emesis has not ceased, it becomes worse. This is accompanied by increasing constipation and abdominal distension, with a rapid pulse and a moderate rise in temperature after vomiting has existed some time. A small amount of gas and even faeces may be expelled from the rectum, but this tends to decrease in amount as the symptoms increase in severity. Gas-pains are present from the first, producing severe paroxysms of colic, so that in a short time the patient shows evidence of acute suffering with alternating periods of restful calm.

In the majority of cases the symptoms come on after the second day and before the end of the first week, though they may appear earlier or be delayed even for several weeks or months. When the obstruction is due to the contractions of bands of adhesions, it will be delayed for a considerable time, whereas that due to some accident of operation will produce symptoms within a few hours. Vomiting is early, spontaneous, more or less constant, and persistent. Regardless of the amount of fluid ingested, the patient will suddenly eject a large quantity of fluid with all food particles unchanged. As the distension increases the vomitus changes to a dark-brown, sour-smelling fluid. This eventually becomes definitely faecal, showing that reverse peristalsis has occurred. In the paretic variety of obstruction emesis is absent at first but occurs later, and in all respects as described.

Constipation is an important symptom but apt to be misleading. Some flatus is usually expelled early in obstruction but this soon ceases. Hard faecal masses may also come away, or there may be two or three free movements before the obstruction is complete. When obstruction is once established, however, spontaneous stools do not pass and enemata return clear. Where the obstruction is very low the colon-tube will be admitted but for a short distance, and enemata may not be retained. On the other hand, in paralytic ileus, the tube is passed readily, the enema is retained and may not be returned at all. An intermittent discharge of mucus from the rectum preceded by severe pain and tenesmus is noted by certain clinicians as rather characteristic in colonic obstruction.

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[1] Angus M'Lean, *Annals of Surg.*, 1914, vol. lix. p. 407.

Abdominal distension may occur either before or after emesis, and is a constant, gradually increasing condition. It is at first local and is always more marked at one point. In sigmoid obstruction the distension is most apparent in the left iliac region, whereas in paresis the upper portion of the small intestine, the jejunum usually, presents the greatest protrusion. The extent of the distension depends on the degree of the occlusion and, in part at least, upon the condition of the abdominal wall. Where the wall is thin and relaxed or diastatic, the distension is more prominent, and in such cases the dilated intestinal coils may be outlined visually. The abdomen is quite rigid and tympany is pronounced unless there be extensive adhesions between the intestines and the abdominal wall. Tenderness is not marked but palpation may excite a paroxysm of colic.

The pulse becomes rapid early and remains so constantly, ranging from 100 to 140 with a tendency to be weak and feeble. The temperature is rarely over 101° F. unless peritonitis forms an added complication. In paretic obstruction the temperature remains normal, but in either variety, as collapse ensues, it becomes subnormal.

Diagnosis must be differentially made between the two varieties of obstruction, and between obstruction and peritonitis. Coming on during the first week after operation such differentiation is relatively impossible. Traumatic peritonitis may ensue from the start, after an operation, and intestinal occlusion occur as a secondary result. Septic peritonitis, in turn, may be imposed upon the clinical picture secondarily to obstruction. In either case the diagnosis would be most obscure. The consideration of probably existing conditions must be most carefully entered into, therefore, since the treatment must vary according to the diagnosis. Unless the symptoms of obstruction are clear, the conservative influence should predominate in the management of a large group of cases as well as in the isolated instance.

ORGANIC OBSTRUCTION	PARALYTIC ILEUS	PERITONITIS
Vomiting spontaneous, early, persistent. Large amounts. Eventually faecal.	Vomiting later, then copious and persistent; eventually faecal.	Vomiting intermittent, may be prolonged. Worse after taking food.
Colon-tube may be passed but a short distance. Enema not retained, and no flatus after obstruction is permanent. Constipation the rule. Intermittent discharge of mucus.	No spontaneous stools but flatus obtained with colon-tube. No obstruction to tube. Enema retained. Constipation the rule.	Little or no flatus, but colon-tube passes readily and enemata retained and returned with faecal material. Constipation absolute.

Distension early and constant, gradually increasing. Most marked in left region, with dysperistalsis. May become extreme. Intestinal coils may be seen; some rigidity.	Distension later, general, constant, aperistalsis. May be extreme. Intestinal coils may be seen; no rigidity.	Distension general from the first; no peristalsis felt or heard. Never so extreme. Rigidity marked. No abdominal respiratory movement.
Tympany pronounced.	Tympany pronounced.	Tympany moderate.
Tenderness little or moderate.	No tenderness.	Tenderness very marked.
Pain in paroxysms of colic, severe.	No pain but sense of fulness.	Pain intense, constant and colicky.
Pulse rapid early and remains high, 100 to 140, weak and feeble later.	Pulse rapid later, but remains up, and soon weak and feeble.	Pulse rapid, but in proportion to temperature thin and thready.
Temperature not high, rarely over 101° F. Subnormal with collapse.	Temperature normal, later subnormal.	Temperature high at once and fluctuant in sepsis.
Leucocytosis 20,000 at first, Later a drop to 10,000 may indicate gangrene.	Leucocytosis 12,000 to 15,000. Decrease with collapse.	Leucocytosis high from the start, polynuclear percentage raised.
Aspect of acute distress during paroxysm, relief after.	Distress only in proportion to amount of distension.	Aspect of constant agony.

Prognosis.—Where the symptoms are fairly clear and do not supervene until after the first week, so that the diagnosis is not obscured, the prognosis is good if surgical care is given promptly. On the other hand, with obstruction occurring during the first week, or with peritonitis also present, delay in operative interference, due to uncertainty as to the diagnosis, will lead to a fatal termination. As a result of the rapid draining away of the body-fluids, especially if associated with acute gastric dilatation, the prognosis becomes grave in paretic obstruction. Küttner has recently reported 456 cases of ileus, 93 of the dynamic type, with a mortality of 60 per cent; 242 of obturation ileus, mortality 44 per cent; and 105 of strangulation ileus, mortality 61 per cent.

Prophylaxis.—The prevention of adhesions provides a theme which occupies a large place in the literature of abdomino-pelvic surgery. And when the various technical procedures, simple and elaborate, which have been advocated for this purpose are analysed theoretically or tested by practical application, the greatest measure of success in avoiding accidental peritoneal attachment will result from the observance of the following technical points:

1. Traumatizing the peritoneal surfaces, especially intestinal, as little as possible.

2. Freeing such structures as are to be extirpated before excising them. Thus, in pyosalpinx-masses, any adherent fold of the sigmoid flexure or caecum or loop of the ileum should be freed first, and the infiltrated tubes and ovaries then loosened from their bed of adhesions before their removal is attempted.

3. Rapidity of work and careful peritonization are two factors which should go together as of equal importance. The freeing of adhesions in cases of inflammatory masses or of tumours may require time, but the extirpation should be performed without delay. In simple plastic procedures, such as round-ligament shortening, where no adhesions exist, there should be no cause for tedious performance and no raw surfaces should be left. Where, however, extirpation produces an oozing line, or extensive and dense adhesions have left wide areas of denudation, careful closure by the approximation of peritoneal folds is fully as important as facility of workmanship.

4. Sufficient exposure is an essential to rapid and, at the same time, careful work in the abdomen and pelvis, and hence becomes a factor in the prevention of post-operative adhesions.

Treatment.—The treatment of this serious post-operative complication depends upon a more or less accurate diagnosis as to the actual conditions present. Up to the point of determining that an actual obstruction exists, the treatment, as outlined under persistent post-operative emesis, should be vigorously pushed. A drop of croton-oil in one ounce of glycerin is given by mouth, and efforts to relieve the distension by the long colon-tube are undertaken. Colonic flushings of soap-suds containing an ounce of turpentine, or enemata of olive-oil and glycerin, or of magnesium sulphate may be effectual. Eserin salicylate (gr. $\frac{1}{10}$) injected hypodermatically is often of definite value. Pituitary extract (1 c.c. of 20 per cent solution) is again recommended by Stevens. Digitalin and strychnia sulphate in appropriate doses are well indicated in most of these cases. Medication, so far as possible, should be carried out subcutaneously or *per rectum*, as the persistent nausea renders uncertain absorption by the stomach. For the same reason, feeding the patient is difficult and loss of strength ensues.

When once the condition of obstruction is determined upon, treatment must be definite and without delay, as neglect always results in peritonitis. The abdominal wound is reopened and the point of obstruction sought. Commencing at the ileocaecal junction the ileum, if collapsed, is followed up, coil after coil, until the obstruction is discovered. Where distension is found at the ileocaecal valve, the obstruction is farther down, usually in the sigmoid flexure or rectum. When found the obstruction is freed. This may prove to be a very simple thing, as cutting an adhesive band or separating one loop of intestine from another. On the other hand, it may prove to be as serious a procedure as the repair of the torn gut-wall or its resection where gangrenous.

Where such extensive lesions are found to exist, always in the presence of localized peritonitis at least, much the better plan is to avoid any present attempt at resection or repair. Rather, here, it is wiser to establish drainage for the distended bowel by fastening the first distended loop to the margins of the incision and opening it. As a rule, in such serious complication, the patient is extremely weak and will not withstand the further shock of a prolonged or traumatic operation. Besides, not infrequently a distended coil is already adherent to the parietal peritoneum. The establishment of an artificial anus, then, by colostomy is, in the great majority of cases, all that is necessary in the mechanical type of intestinal obstruction. This gives speedy relief, and the opening may even close spontaneously after recovery. In case it does not, operative closure is readily effected when the patient's condition will permit.[1]

In paretic obstruction the same general principle will hold good, but the procedure is somewhat different. Here, as has been stated, the distension is most frequently found in the upper portion of the small intestine. High intestinal stasis is much more serious than low obstruction and requires very prompt treatment. Under local anaesthesia an incision is made well above and to the left of the umbilicus, a point in the abdominal cavity where the upper portion of the jejunum is most accurately picked up.[2] The first distended loop of bowel that presents itself, however, is the one to be tapped in order to drain away the large quantity of brown fluid which collects here. After its evacuation vomiting soon ceases and the patient improves. The presence of pancreatic secretion at the site of the enterostomy is evidence of the presence of duodenal fluid, and a relationship between the welfare of the patient and the presence of pancreatic secretion will be noted.

If performed early enough no doubt enterostomy at any point in the small intestine will give relief. The essential thing is that where the patient lies in the extreme degree of shock common to acute ileus no attempt should be made towards exploration. Any interference further than the establishment of drainage will be done at increasing risk to the patient. Duodenal drainage must continue until the intestinal paresis has entirely subsided. This is hastened by the introduction of a small tube or catheter into either side of the loop that is tapped. Appreciable relief of the distension requires several hours, and after this the introduction of normal salt solution in small quantities is of value. It aids mechanically in washing out the secretion and gas from the duodenum and, by absorption, provides the greatly desired stimulation.

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[1] The technique of this procedure is described on page 559.—Editors.

[2] C. H. M'Kenna, *Surg. Gyn. and Obst.*, Aug. 1912, p. 150.

The patient's condition will determine the time for closing the jejunostomy, though two weeks is the minimum length of time for it to remain open. It does not tend to close spontaneously. Subsequent to the re-establishment of feeding, however, normal intestinal contents will begin to appear and emaciation will speedily follow. The attached loop of bowel must then be freed and resected. Intestinal continuity is then re-established by lateral anastomosis in the ordinary way.

Acute Dilatation of the Stomach

Acute gastrectasia may follow any abdominal operation and is almost uniformly fatal if not recognized early. In many respects it resembles paretic obstruction and suggests an identical or strongly similar etiology. Indeed, it may be an end-result of ileus. The stomach is paralysed, as a result of which its motility ceases and it becomes distended. But more than this, there accumulate quantities of fluid so large as to suggest a grave circulatory disturbance. The vascular and lymph channels first become dilated and then pour such quantities of fluid into the stomach that it becomes enormously dilated. This takes place very rapidly and is characterized by great shock. Again, as in intestinal paralysis, the condition is more apt to occur in the asthenic type of woman, especially where visceral ptosis is already a recognized abdominal feature.

The *symptoms*, as a rule, appear suddenly. There is epigastric distress, fulness in the abdomen, with a quick rapid pulse, the temperature falling. Partial or even complete anuria develops and the patient goes rapidly into shock. The abdomen is distended and tympanitic, though dulness may be present over the upper abdomen, representing the area over the stomach dilated with fluid. In such event fluctuation may be elicited, though the tension is oftener too great to make this possible. There is no tenderness, as in peritonitis. Emesis may not occur at all, or, on the contrary, the patient may eject large quantities of the characteristic dark-greenish fluid. After vomiting, relief is obtained for a short time only, the stomach having been but partially emptied. As a result of such extreme loss of the body-fluids, thirst and a marked decrease in strength are observed. The features become anxious and pinched, and the patient is restless and worried. If water is taken by mouth, emesis becomes more marked without relieving the distress. The pulse is always rapid, out of proportion to the temperature, and later thin and thready. Death may supervene in a few days.

Prompt recognition of the condition and energetic treatment are the two essentials in acute gastric dilatation. The stomach-tube will be of greater assistance here than anything else. Even where the patient vomits freely the amount of fluid that will be withdrawn by the tube is remarkable. In one case of the writer, after an operation for shortening the round ligaments and lower plastic repair, sixteen pints of fluid were withdrawn in five aspirations during the course of forty hours, the patient eventually recovering. After the stomach is emptied, eserin salicylate, or pituitrin, and strychnia sulphate are given in such doses as the patient's condition may indicate. No food or drugs are offered by mouth, but small nutrient enemata are substituted. The stomach is drained at regular intervals, and the tube may be required in this way for two or three days. Gradually the amount of fluid withdrawn becomes less and less until the stomach ceases to dilate and the abdominal distension subsides. Only after the stomach shows no further tendency towards paralysis may the loss of fluids be made up by the transfusion of salt solution, or may food be taken by mouth in ordinary quantity. Once this is possible, however, recovery may be assured.

Suppression of Urine

After all such operations as the graver abdominal ones, there occurs a marked decrease in the total quantity of urine for twenty-four hours. After forty-eight hours, or sooner, the increase should be gradual, until the total quantity is again normal by the end of the first week. Such a diminution, therefore, need occasion no alarm unless it persists beyond the second day. In such a case the diagnosis lies between ureteral obstruction and nephritis. The former may be ruled out unless one or both ureters came directly into the field of operation or were closely approached, as in hysterectomy, when the obstruction may be due to the involvement of one or both ureters in the ligatures or clamps. If both ureters are so involved, the urinary suppression will be absolute, with pain on both sides, whereas, if but one ureter be ligated, the diminution is marked and the pain is limited to the involved side. Microscopic examination of the urine will probably show blood-cells. Since the patient's condition usually precludes cystoscopy and sounding of the ureters, the diagnosis must be arrived at from the symptoms and urinalysis.

Acute nephritis rarely follows an operation except where the kidneys previously have been diseased. In such case, instead of a marked diminution followed by a gradual increase, there occurs rather a steadily decreasing total daily quantity of urine, with a larger amount of albumen and a greater number of casts than were found before operation. Eventually uraemic symptoms appear, with a more or less rapidly supervening coma.

As a result of the careful preparatory treatment characterizing major surgery to-day, urinary suppression due to nephritis is seen much less often than formerly. The use of ether in minimum amount, routine injection of salt solution after operation, and speed in operating are also important factors. Indeed, in the presence of chronic nephritis, it is not too much to say that ether should be avoided altogether. In the great majority of cases this is entirely feasible.

The urine always should be sent to the laboratory for examination within twenty-four hours after an operation. Where the kidneys or ureters have been involved in the operation, or in case of pre-existing renal disease, the total daily quantity should be carefully measured by the nurse and recorded on the chart.

In ureteral obstruction the treatment is obvious — to reopen the abdomen and search for the point of ligation. The patient's condition may render this a desperate undertaking, yet she is entitled to the chance. While the diagnosis of ligated ureter is often made only at autopsy, on the other hand, cases have been successfully relieved as late as ten days after operation.

Where suppression of urine is due to 'renal shock,' active treatment must be instituted early. A continued decrease after forty-eight hours should be the indication for a saline purge and the copious ingestion of water. An enema of normal salt solution with the long colon-tube is given every six hours. Hot packs or steam baths are not practicable in surgical cases, but even better results are obtained from the injection of large quantities of salt solution subcutaneously. This is placed under each breast in turn, and is often astonishingly effective in lessening the toxic effects of the urine and in increasing renal activity. Should improvement be delayed for another twenty-four hours venous transfusion of salt solution is to be resorted to, not discontinuing the hypodermoclysis or the rectal injections.

By way of drugs, pilocarpine (gr. $\frac{1}{6}$) or spartein (gr. $\frac{1}{6}$) may be given with the needle every four hours. Kelly has used elaterium (gr. $\frac{1}{8}$) in the most serious cases. Where the heart becomes weak and rapid digitalin and nitroglycerin are indicated.

One of the characteristics of acute nephritis is the difficulty in securing elimination. Where coma supervenes despite active efforts towards diaphoresis and catharsis the withdrawal of a pint or more of blood by venesection should be tried. Renal decapsulation has been advocated by certain surgeons, especially Edebohls, as the speediest and most certain method of relieving the dormant kidney-function. The procedure has not been followed by sufficiently satisfactory results, however, to warrant general adoption or advocacy.

Retention and Incontinence of Urine

Urinary retention should be an infrequent complication following operations. It is due to a variety of causes. As a result of the natural and temporary diminution in the total daily renal excretion, the bladder is not filled to its wonted capacity, hence it does not tend to empty itself so readily, especially when the patient is on her back, an unaccustomed position for micturition. Again, where it has been necessary to pack the vagina, pressure against the urethra makes it impossible to void. Aside from these rather mechanical causes for retention, there is a group of cases where the fault seems to lie in injury to the blood-vessels and nerve-supply of the bladder, as where the ganglionic system lying in the broad ligaments is extirpated. A natural consequence of this would be a prolonged paralysis of the *detrusor vesicae* with resultant inability to void. Finally, retention may be a reflex exhibition, following plastic operations about the urethra or vaginal outlet, or where the vesical base has been extensively separated, as in the radical abdominal operation for cervical carcinoma.

The treatment of retention consists in the employment of the usual measures for inducing urination, *i.e.* hot fomentations to the lower abdomen, steaming water in the bed-pan, warm external douches, a copious enema, or a brisk purge. Vaginal packing should always first be removed and the catheter used only as a last resort. Following major operations over-distension of the bladder should be guarded against. It should always be borne in mind that a very excessive distension may be present with no tumour or swelling palpable through the abdominal wall, and that a patient may void small quantities of urine frequently and yet have a distended bladder.

Catheterization has been fully considered on a preceding page and need not be taken up again at this point.

Incontinence of Urine.—Urinary incontinence usually represents an overflow as a result of a distended bladder but may mean a vesico-vaginal or a uretero-vaginal fistula. Vesical distension has been referred to already and its treatment outlined. Vesical or ureteral wounds most frequently follow vaginal hysterectomy or the radical extirpation for carcinoma of the cervix. They are also found after plastic procedures on the bladder and ureter, or on the anterior vaginal wall. The danger of such incontinence is not so much from the escape of urine through the vagina as from ascending infection, producing a cystitis, a pyelitis, or both.

Where the injury is to the bladder, it should be irrigated once or twice daily with a boric acid solution until clean, whereupon the fistula may close spontaneously. Where small, this occurs not infrequently. If spontaneous closure does not occur, the operation for vesico-vaginal fistula is to be undertaken (p. 654). Regarding this procedure it is in place in this chapter to emphasize but one point. The edges of a post-operative vesical fistula are made up of soft recent cell-structure, granulation tissue that may be clean but difficult to bring together into primary union. Efforts to close at once are often, therefore, disappointing, and it is always better, in such cases, to put off repair for two or three months. By this time the scar-tissue will have become firm and closure is much more readily effected.

For the same reason, and because of its greater inaccessibility, uretero-vaginal fistula should also be allowed to close spontaneously. The inconvenience to the patient is considerable and the danger of ascending infection is constant, yet spontaneous closure occurs often enough to justify waiting. When operation eventually becomes necessary the ureter is transplanted into the bladder, either by operation through the vaginal vault or through the abdomen. In case of failure by either of these methods, nephrectomy becomes necessary. This last operation should be approached only after ample time has been given for spontaneous closure, and after careful cystoscopic examination has revealed the condition of the bladder and the integrity of the opposite kidney.[1]

Cystitis

The frequency of inflammation of the bladder, considered as a post-operative complication, has always been considerable, varying markedly in the experience of various clinicians and according to the nature of the operations performed. Thus Taussig[2] showed some years ago that in thirty-five radical panhysterectomies for cancer, cystitis developed in 64 per cent of the cases, whereas it appeared in but 14 per cent after extensive operations for prolapsed uterus, and in only 2 per cent in vaginal hysterectomy. At that time he regarded 15 per cent as a fair average of frequency, but in the experience of the writer it should fall considerably below that mark to-day.

Among the direct causes leading to cystitis, trauma and urinary retention undoubtedly play an important part. Ecchymotic areas are comparatively frequent, as is superficial desquamation of the epithelium, and the frequency and severity of the affection are directly proportionate to such injuries. Paralysis with retention of urine becomes a factor in so far as the stagnant urine provides opportunity for bacteria to multiply. Both of these factors may be present, however, without cystitis, so that, when all has been said, the entrance of infective micro-organisms into the bladder is the chief cause. Indeed, infection without trauma or retention occurs only too frequently.

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[1] See also Article on Fistulae (p. 662).—EDITORS.

[2] F. J. Taussig, *Surg. Gyn. and Obst.*, 1900, vol. ii. p. 181.

The bacteria producing infection may have been already in the bladder; the existence of a previous cystitis should not be overlooked. On the other hand, they may have traversed the traumatized vesical wall from the rectum, from the vaginal wound, from infection about an implanted ureter, or may have entered the viscus directly from the urethra. It is now well established that the urethra in women confined to bed contains staphylococci and colon bacilli, that sterilization of the urethra is virtually impossible, and that cystitis is, in almost every case, a colon-bacillus infection. In the last analysis, therefore, post-operative cystitis proves to be a catheterization cystitis.

The pathology and symptomatology of vesical inflammation need not be entered into at this time. The prognosis is good if treatment is active and early, the greatest danger lying in the opportunity presented for an ascending infection along a ureter to the kidney.

Prophylactic measures are practically determined by the etiological factors just outlined. The important thing is to secure spontaneous voiding after operation and to catheterize as seldom as possible. As has been noted in an earlier paragraph, the use of the catheter a few times rarely results in infection, but its prolonged employment, as in retention extending over five or six days, is nearly always followed by a breaking down of resistance and a rapid increase of bacteria with beginning inflammation. Wherever catheterization must be continued for some time the bladder should be irrigated each time with one quart of boric acid solution, continuing the irrigation until there is no longer any residual urine. Some surgeons advocate filling the bladder at once after operation with a solution of boric acid or of boro-glycerin. In the experience of the writer this has not been regarded as necessary.

It should go without saying that during the operation the bladder must be manipulated with extreme care and any denuded surface covered as well as possible. Peritonization has been too often neglected after vaginal hysterectomy or the interposition operation. Internally, urotropin (gr. v) should be given four times daily.

The *treatment* of cystitis consists in washing out the bladder once or twice daily with a warm saturated solution of boric acid or potassium permanganate, 1 in 5000. The average case will clear up readily, but where the inflammation is less tractable a 1 per cent solution of protargol once daily has proved very efficient. The irrigation is to be carried out, of course, with every aseptic precaution. The return-catheter should not be used, as it prevents the bladder from being filled, until every portion of the mucous membrane is bathed in the solution. A glass or rubber catheter attached to the irrigating funnel is preferable. The fluid is allowed to run into the bladder by elevating the funnel and should remain there for a short interval, after which it is let out by detaching the tubing from the catheter. The procedure is repeated until the fluid returns clear.

Where the urine remains acid, urotropin (gr. v) or salol (gr. x) is given by mouth every six hours. In the presence of alkaline urine, acidity should be brought about with potassium citrate, as urotropin is more effective in an acid medium.[1]

Urinary Fistula of the Abdomen

The bladder or ureter may be injured in the course of an abdominal operation, and, where drainage is employed, a fistulous tract leading to the lower end of the wound may result. In the light of present-day technique and knowledge of anatomical relations this should be one of the rarest of complications. The writer has seen but two cases in his experience. In the first case the bladder was incised in a second effort to drain more perfectly a general abdominal tuberculosis. An immediate attempt at closure failed, and it was several months before leakage ceased spontaneously. In the second case an extensive inflammatory mass filled the entire pelvis and, after enucleation, a small fistula appeared in a drainage stab wound on the left side. This failed to close spontaneously after three months' delay, at the end of which time an operation for uretero-cystostomy was successful.

As a rule the escape of urine giving evidence of ureteral injury will not appear until some days after operation, whereas a bladder-wound will discharge urine from the first. In a clean case such a wound should be recognized at once and repaired instantly. Small fistulae involving the ureter tend to close spontaneously and should therefore be left alone. A small rubber tube placed in the tract will aid in carrying the urine away from the abdominal dressings. If, after ten or twelve weeks the discharge persists, transplantation of the ureter into the bladder should be attempted. In case this is impossible, uretero-ureteral anastomosis is best undertaken. Only after these procedures have been tried and have failed, or in the face of a large ureteral opening of long standing with infection, should nephrectomy be considered. Transplantation of the ureter into the colon has not given results sufficiently satisfactory to justify the operation.

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[1] The treatment of Cystitis is also considered in the Article on Urinary Infections (p. 197).—EDITORS.

Phlebitis

This interesting complication occurs in about 1 per cent of all abdominal operations, being oftenest found after operations on the uterus, especially hysterectomy. Its cause is not thoroughly understood, but it seems most probably to arise from a mild infection in the vicinity of the pelvic veins on one side. This produces a phlebitis and the formation of a clot which spreads gradually out into the femoral vein on the same side, usually the left. At all events, by the time it is discovered the condition is nearly always a thrombosis of the femoral vein, though in rare instances the popliteal or tibial veins would appear to have been primarily involved. It usually occurs towards the end of the second or during the third week of the convalescence, and in patients who are run down or very anaemic. Bonney[1] regards the condition as a generalized septicaemia of a peculiar nature, a view apparently substantiated by the fact that it is most often preceded by severe or complicated pelvic conditions, such as inflammatory masses or adherent tumours, actually or potentially infective and demanding considerable trauma in their enucleation.

Symptomatically, phlebitis is characterized by deep-seated pain in the line of the thrombosed vessel, accompanied by a rise in temperature and a pulse correspondingly quickened. The vein becomes hard and swollen, so that it is readily palpable, being at first very tender and often nodular. As a result of the thrombosis the limb becomes swollen, at first the thigh, then the entire leg. The pain may be very severe and precede the swelling a few hours. Where the superficial veins are involved a red line will be seen marking their course. The fever is never very high, at the most 102° to 103° F. After a few days the pain ceases, discomfort in the leg only being complained of. The swelling, however, does not subside until the collateral circulation is established, a matter of several weeks or months, during which time the most annoying symptom is a lameness. In every respect this condition is identical with the *phlegmasia alba dolens* of the puerperium.

Recovery is spontaneous in a few weeks or months, though the patient need not be confined to bed after the pain and fever have subsided. During the acute stage she should be kept quiet in bed, with the affected leg elevated. Dry heat for pain and a flannel bandage applied with firm pressure will give relief. Heroin (gr. $\frac{1}{12}$) may be required for a day or two. The patient is under treatment for general septic infection, hence a light diet and steady elimination by the bowels and skin. She must be warned against the danger of a clot becoming free with resultant embolism. For the same reason massage is absolutely contra-indicated. Walking will be difficult at first, and should not be indulged in to any extent until all swelling has disappeared.

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[1] Victor Bonney, *A System of Treatment* (*Latham and Crisp English*), 1912.

Pulmonary Embolism

Of 439 fatal post-operative cases of pulmonary embolism reported during the past fifteen years, 366 followed abdominal operations. Since this series Petren[1] has analysed 57 other cases with fatal termination, 38 of which also followed abdominal surgery. A remarkable fact is brought out, that in operations on the head, limbs, and upper thorax pulmonary embolism rarely ensues. Petren's figures show that fatal embolism occurs in 1 per cent of all operations for uterine myoma and cancer, only half as often (0·5 per cent) after other laparotomies, and only 0·3 per cent after appendectomy. Age and sex are apparently of no influence, nor the general condition as a rule, though changes in the cardio-vascular system evidently co-operate. The accident has occurred in robust individuals after simple herniotomy. In half of Petren's cases the thrombus developed first in an iliac or hypogastric vein and generally on the left side. Of six cases following appendectomy the primary thrombus occurred in the left hypogastric vein five times. The primary thrombus is thus rarely connected directly with the operative field, almost never with surgical laparotomies, rarely after hernia, bladder, and perineal operations, and in less than half of the gynaecological laparotomies.

Two-thirds of Petren's fatalities occurred between the fourth and fourteenth days. Infection is a comparatively rare factor, though a slight fever of no discoverable cause should warn of a possibly impending thrombosis. The majority of clinicians certainly regard infection as the basic factor in thrombosis. On this theory, embolism is explained as secondary to a thrombosis due to so slight a degree of inflammation as to leave the vessel-wall intact, hence the clot is very loosely attached. In a definitely stamped attack of phlebitis and thrombosis, then, the clot is so firmly adherent in the vessel-lumen, and so well organized, that it cannot become loosened or broken, hence embolism need not be feared.

Ribbert[2] and Petren, on the other hand, regard defective composition of the blood and a poor circulation as the main factors. The long, loose structure of the emboli makes it easy for them to be swept away into the blood-stream, and they must be regarded as the product of coagulation.

Contributing causes are sudden or excessive effort, such as sitting up in bed, straining at stool, coughing, change of position in dressing wound, driving in a cab, etc. With such effort the symptoms of embolism come on very suddenly.

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[1] G. Petren, *Beitr. z. klin. Chir.* vol. lxxxiv. No. 3, p. 499.

[2] H. Ribbert, *Deutsche med. Wochenschr.* vol. xl. p. 1409.

The patient complains of pain in her side or beneath the shoulder blade. Respiration rapidly becomes gasping, and there is evidence of precordial distress. A cold, clammy sweat appears on the face and the skin is cyanotic. At first her mind is clear, but with the violent struggle for breath she loses consciousness. The pulse is very feeble and too fast to count, but the heart continues to beat perceptibly after respiration has ceased. Death usually ensues within a few minutes. Where the clot is so large that it entirely blocks the pulmonary circulation the heart will stop at once, the patient dying instantaneously. In the more fortunate cases, however, where the embolus is small, the attack is characterized by precordial distress, pain, dyspnoea, and a quickened, feeble pulse. There may be one or more attacks, from which the patient recovers completely.

The *prevention* of embolism should normally include stimulation of the heart and improvement of the blood, increasing the haemoglobin-content, etc., by way of treatment preparatory for operation. Loss of blood during operation is to be avoided, and its circulation promoted afterwards by active and passive exercise of the legs in bed. A change of position and light massage of the legs will not be contra-indicated so long as there is no evidence of thrombosis. Ribbert even suggests the reduction of the coagulating property of the blood as the important factor in warding off pulmonary embolism.

As for *treatment*, there is little or nothing to do in the more severe attacks. Only where the seizure is of slight or moderate import will the physician or nurse have opportunity to reach the patient in time to be of any assistance. She should be placed on her back and given stimulation. Brandy by mouth and ether or strychnia subcutaneously will serve this purpose. Oxygen gas will be of the greatest value provided it is speedily available. Artificial respiration is indicated as long as consciousness is lost and the heart beats. In extreme cyanosis, venesection may be tried if the heart is strong. The value of pituitary extract, as advocated by Stevens, would likewise depend altogether upon the condition of the heart.

Operative removal of the embolus has recently been advocated.[1] Aside from the risk of such an extensive procedure, unfortunately there is rarely time for assistance in any form. In but seven of Petren's fifty-seven cases were conditions such that removal of the embolus might have been attempted with any chance of success.

Pneumonia

Pneumonia is another of the more severe post-surgical complications which is much less frequently seen in modern practice. It usually followed prolonged ether anaesthesia, or was due to the inhalation of foreign material — inspiration-pneumonia. Undoubtedly exposure of the body during operation was an important factor. Resistance is lowered by the operative shock and by exposure, a bronchitis is produced by the ether, so that any infective micro-organisms present are able to become active. A graver form of pneumonia, the embolic, is produced by septic emboli from a focus of infection at the seat of operation lodging in the pulmonary capillaries.

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[1] E. D. Schumacher and W. Jehn, *Zeitschr. f. d. ges. exp. Med.*, 1914, vol. iii. No. 3, p. 340.

Broncho-pneumonia, to-day, runs a rather typical course, as a rule favourable, soon reaching the crisis. It comes on at once, or soon after operation, and presents the well-recognized signs and symptoms of pneumonia. The septic form arises gradually, often many days after operation ; the symptoms are so closely associated with those of general septicaemia as many times to escape notice, if, indeed, the pneumonia is not merely one expression of a general septic infection. Rapid breathing, more or less dyspnoea, and a slight hacking cough with a moderate muco-purulent expectoration are the chief symptoms. The isolated pneumonic patches give little evidence of their presence, at times a few dry râles being heard. In spite of such mild local evidence of disease the patient appears to be desperately ill. In most cases pleural effusion rapidly forms, often becoming purulent. The prognosis is necessarily grave.

The treatment of bronchial and lobar pneumonia is expectant and stimulant, to be carried out along well-recognized lines. In the septic type vigorous supporting measures are required. Aspiration of the thorax is usually indicated.

In the light of our present knowledge of operative technique, pneumonia should be an exceedingly rare post-operative complication. Without doubt, one of the chief factors in its production in past years was the old method of ether-anaesthesia. Certainly, since open ether-inhalation has been in vogue, there has been a marked decrease in both bronchitis and pneumonia. Along with this improvement came better ideas as to cleanliness on the part of the anaesthetist and his equipment, Fresh sterile gauze on the mask, or cone, for each patient and sterile tongue-forceps, throat-swab, and mouth-gag are now ordinary requisites. Indeed, it would not be going too far to require the so-called ‘ sterile anaesthetic ’ as a routine in all major operations. Keeping the throat cleansed of mucus goes without saying, for more reasons than one. The preparation of the patient's mouth should not be neglected, especially with respect to the teeth. No individual who has pyorrhoea alveolaris should be given an inhalation anaesthesia except in emergency. Finally, the protection of the patient from exposure by having the operating suite warm is still too often neglected. Not only the surgical ward but the corridors through which she is brought from her bed should be thoroughly warmed, while the patient herself is well protected from unavoidable chill or draught by a woollen blanket.

Hernia

The causes of post-operative scar-herniation all produce the same thing, a separation of the edges of the fascia in front of the recti muscles. The integrity of the abdominal scar depends entirely upon the proper union of this aponeurotic sheet. Poor approximation, then, of the fascial edges in closing the abdominal wound is the first factor in the production of hernia. Other very apparent causes are drainage, wound infection, and poor abdominal support from an improperly applied binder at once after operation. Excessive vomiting or coughing, as well as straining at stool or lifting, occasionally bring about separation of the fascial edges. In a few cases malnutrition seems to delay or interfere with perfect union. Months after operation the scar may give way as a result of a rapid abdominal distension associated with pregnancy or ascites.

Most herniae take place in the lower portion of the wound, very few above the umbilicus. This is due to the facts that intra-abdominal pressure increases from above downwards and forwards, due to the weight of the intestines, and that drainage, when employed, is always through the lower angle of the wound.

The objective symptoms are the same as in other forms of hernia. Subjectively the symptoms vary largely according to the degree of rupture and to the individual conditions. Pain is the chief complaint, often characterized by frequent attacks of colic, or it may be indefinite, as if due to adhesions. If situated low down, adhesions will produce frequent urination and dysuria. Constipation and digestive disturbances often are present.

As a rule the opening is so large, in this form of hernia, that strangulation is not apt to occur. In some cases the protrusion of the intestines is so extensive that a large tumour is formed, rendering the patient helpless. If the peritoneal sac should now rupture the omentum or small intestine would become adherent over a large area to the subcutaneous tissue, thus producing great distress, if not an abdominal crisis. Where the area of rupture is small, strangulation, of course, is always possible.

Where the hernia consists of a diffuse relaxation of the entire breadth of the abdominal wall, treatment is best carried out by a properly adjusted abdominal support, which is worn constantly while the patient is out of bed. If an operation is undertaken, it is carried out along the prescribed lines of cure for ventral hernia. Where the fascia is greatly thinned out it may be considerably strengthened in this operation by imbricating its folds, either from side to side or from above downwards.

Reinforcement is also very effectively secured in marked relaxation by the transplantation of fascia lata.

Where the hernia is smaller, due to a separation of the fascia or a mere bulging between separated muscles, operation is the radical cure. The tendency on the part of all ruptures to enlarge spontaneously, in spite of the abdominal belt or truss, is sufficient argument against tentative management in such cases.

By far the most important thing, however, in the question of post-surgical herniation, is its prevention. Every effort must be made, in wound closure, to bring the edges of each layer into definite approximation. As has been stated previously, this is best accomplished by preparing the wound for closure while opening the abdomen. The superficial fascia, in the median incision, is carefully divided throughout the length of the wound, and the two recti muscles are freed from their sheaths. Where these recti are separated, as in diastasis, care is taken to dissect the aponeurosis free from the underlying fascia and peritoneum, so that every bit of it may be preserved. Here it will be necessary to carry the incision above the umbilicus, excising this, the weakest point in the abdominal wall, so that the recti may be dissected free as far as they are separated. The peritoneum is then incised and the operation performed. In closing, the peritoneum is first sewed up with a continuous catgut thread. Retention-sutures are then placed. These are of heavy material and pass through muscle, fascia, subcutaneous fat, and skin on each side. The gutta-percha silk braid suggested by Webster[1] is an excellent material for this purpose, being sterile, pliable, and possessed of great tensile strength. These are placed between one and two inches apart, and are not tied until after the skin-edges have been approximated. The fascia is then closed over the muscle, being imbricated where it is very thin and lax. This is done by an interrupted over-and-over catgut suture. The skin is closed by the Michel's clips, by silkworm-gut, or by a continuous, interlocked black silk, care being taken to leave room for skin-drains where there is an abundance of subcutaneous fat. In the writer's experience with clean cases, *i.e.* no drainage or wound infection, there has been no case of herniation following such closure.[2]

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[1] J. Clarence Webster, *Diseases of Women*, 1907.

[2] The operative treatment of this form of Hernia is also described in the Article on Hernia in Women (p. 241).—EDITORS.

GENERAL GYNAECOLOGICAL THERAPEUTICS

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Summary

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IV. Electricity. Electric heat and light baths. High-frequency currents and diathermy.

V. Balneo-therapeutics.

VI. Vaccine-therapy.

I. INTRODUCTION

The science of gynaecology was only superficially taught and practised up to about 1870. In the early *Transactions of the Obstetrical Society of London* (founded in 1858 for " the Advancement of Obstetrics and the Diseases of Women and Children ") it is noticeable that, unless associated with a co-existing pregnancy, only the more obvious gynaecological conditions were discussed. Thus in 1859, out of 41 communications, there were only 4, *i.e.* 10 per cent, which dealt with gynaecological conditions (fibroids, ovarian cyst, polypi, vesico-vaginal fistula); in 1869 there were 25 per cent; in 1879 gynaecological papers constituted 38 per cent.

In 1889 surgical gynaecology, under the influence of antiseptics, was becoming well advanced, and 58 per cent of the subjects discussed were gynaecological. In 1899 the percentage rose to 63 per cent, and in 1909, the last year of the Society's separate existence, the percentage was 65 per cent, as compared with only 35 per cent in obstetrics.

There is now, however, distinct evidence that the advance of gynaecology along surgical lines is being arrested by the advances made in other therapeutic directions, and it seems possible that the long-deferred hope that radical major operations upon the uterus may be safely omitted, may be fulfilled in the near future.

To take two concrete examples of this tendency, one may observe that just when Wertheim's radical operation for the treatment of advanced *carcinoma cervicis uteri* was becoming recognized, in spite of its 18 per cent immediate mortality, as the only treatment at all likely to save life, Döderlein and others published numerous cases treated by local radium emanations with complete symptomatic relief. It is considered that some of these, at all events, may turn out to be permanent cures. The same surgeons also, and many others, lay claim to the cure of haemorrhagic fibromyomata, of all sizes, by exposures to Röntgen rays. Enthusiasts in these methods state that radical operations for these uncomplicated conditions will soon be considered unnecessary, in view of their successes.

Bacteriology again, especially vaccine-therapy and perhaps metal colloidal injections in cases of infection, are likely to prevent destructive streptococcal and gonococcal inflammation in the upper generative areas. The diagnosis of syphilis by the discovery of the *Spirochoeta pallida* in 1905, and by the Wassermann reaction in 1906, and the speedy amelioration of symptoms under Ehrlich's salvarsan, will almost certainly prevent, and perhaps cure the later cirrhotic action of the disease upon the uterine vessels and muscle, which is now believed to be a factor in the cause of many of the cases of uterine haemorrhage in 'fibrosis uteri' and 'chronic metritis,' which now yield to nothing short of hysterectomy.

The acceptance of the theory of an internal ovarian secretion, and the association of excess of lutein tissue with many cases of hydatid mole and chorionepithelioma, and its supposed influence upon the early processes of pregnancy, all tend to make surgeons more and more averse to removing either ovary when performing hysterectomy for fibromyomata. The nature and value of the internal secretions of the other ductless glands, and the fact that their metabolism is in organic harmony with that of the ovary, has opened up a new chapter in the therapeutics of gynaecology and obstetrics, and organic extracts from all these ductless glands are already being used for the treatment of such diverse conditions as menorrhagia, dysmenorrhoea, menopause-phenomena, uterine atony, intestinal paresis, and irritable bladder.

As an interesting evidence of this tendency towards a less surgical gynaecology, one may mention that Howard Kelly, who in 1898 published his world-renowned *Operative Gynaecology*, has now written an equally admirable work of 700 pages on *Medical Gynaecology* which has already required a second edition. He, at all events, is fully alive to the altered tendency now becoming evident, for in his preface he says "the period of surgical evolution is now at last clearly at an end."

With the harnessing of the ultra-violet rays of the spectrum and their use as germicides; and the use of high-frequency currents for such diverse conditions as *pruritus pudendi*, and passive haemorrhages; and the differentiation of the uses of the α, β, and γ rays of radium, medical gynaecology must be further benefited.

General Hygiene.—There are two conditions of life which tend to aggravate if not actually to produce pelvic disorders. The first is luxury, which allows a woman to spend her life in indolence and ease, leaving her mind a prey to morbid introspection, and her body prone to functional debilities, which tend in the one case to hysteria, in the other to neurasthenia. These, especially the latter, are much more frequently observed in the wealthier classes. The second condition of life which aggravates pelvic troubles is continuous over-exertion.

When the article on "Gynaecological Therapeutics" in Allbutt, Playfair, and Eden's *System of Gynaecology* was written in 1906 it was correct to say that physical overwork was " chiefly found in women of the poorer classes, who have neither the opportunities of adequate rest, nor the change of environment, after illness and parturition, which their richer sisters can ensure." Now, however, physical over-exertion and strain are not confined to the poorer classes, and women in the higher spheres of life are vying with each other, and with men, in physical exercises and pursuits for which, anatomically and physiologically, the average woman is unsuited.

The mode of living ought to be between these two extremes of indolence and over-exertion. The mind should be free from anxiety and strain, yet at the same time actively occupied with some healthy intellectual pursuit, which should prevent mental stagnation ; the body should be stimulated by exercise suited to age, tastes, and circumstances ; and, above all, the importance of functional regularity should be insisted upon.

The functions of menstruation and gestation are instances of rhythm in the movements of nature ; the intermissions of the hollow viscera occur in cycles, which are approximately rhythmical. The more the woman is regular in these functional observances—in defaecation, micturition, the toilet of the skin, and exercise both mental and physical—the healthier she will be ; and regularity of meals and sleep, both as regards time and duration, are no less important.

One has only to enumerate the physical exercises now engaged in by women to show how largely their occupations have changed during the last ten years : hunting, golf, association football, tennis, hockey, mountaineering, big game shooting, and aviation.

Unfortunately such devotees appear to be unable to ' sacrifice ' a few days to rest during their menstrual periods, often rendered irregular by these excesses, and they consider it their duty to keep their engagements even in such active efforts as hunting or hockey, often with dire results.

To the growing girl especially, all excess of exertion, especially if prolonged, is potentially harmful. Exercise is of course essential, but never to the point of exhaustion. In addition the organically healthy young woman requires sufficient hours of rest, a refreshing cold bath or cold sponging on rising, unless contra-indicated, nourishing food, including especially a hearty breakfast, personal cleanliness, especially of nails, teeth, and mucous orifices, and attention to the evacuations of the bowels. The growing girl should also be encouraged to accustom her bladder to hold large amounts of urine—a pint at least—and to avoid frequent micturition just because opportunity offers. This enables her to lead a healthy active life untrammelled by the need for unduly frequent and often inconvenient micturition.

Clothing.—It is useless to try to instil any rational views on clothing into the modern woman, who seems unable to adopt a useful compromise between the old skirt and petticoats, which would wind round the limbs, and the narrow skirt till recently in vogue. The shorter, wider skirt, introduced during the last twelve months, is a distinct improvement, though the accompanying transparencies used for stockings are far too thin. The few undergarments now worn should be of wool or silk and wool, and stockings should be warm. The modern corset, with the pressure equally distributed over back, hips, and abdomen, and without an artificially constricted waist, is all to the good. Such corsets, with the assistance of straps along their lower anterior margins, can be made to take the place of the old abdominal belt after coeliotomy and save much inconvenience and alteration of the figure-outline.

II. Drugs

A wide and precise knowledge of the action and uses of drugs is essential in the treatment of disease, whether of one set of organs or another. This is especially true in gynaecology, where, as already indicated, so much depends upon the functional and organic integrity of the rest of the individual. By the stimulation of extra-pelvic secretory organs relief can be afforded to the intra-pelvic viscera. A few words, then, may be devoted to the principles which should guide us in the administration of the more general drugs.

(*a*) **Purgatives.**—In no class of disease are purgatives more useful. Constipation, by allowing the collection of scybala, may displace the pelvic viscera; or by exerting pressure on the venous plexuses round the uterus and in the broad ligaments, may cause congestion and discomfort, and even be the cause of the large varices often seen in the broad ligaments; or, again, acting constitutionally, it may dispose to systemic and portal congestion, which injuriously affect the pelvic organs; or may even cause a type of toxaemia, described so well by Robert Barnes and called by him *copraemia.* In many cases of chronic pelvic disease a course of purgatives, such as sulphate of magnesium, cascara, or aloes, with a few doses of calomel, as occasion may require, will greatly relieve the patient. Dysmenorrhoea, for instance, will often yield to free purgation a few days before menstruation.

Constipation depends upon many factors—sometimes the food is not stimulating enough and does not contain sufficient indigestible material, such as is provided by oatmeal, brown bread, fruit, and green vegetables, especially salads, to encourage peristalsis. The modern plan of giving finely-divided, partly-digested patent foods with strong purgatives, is a faulty method of dealing with constipation, and is only of temporary utility.

In constipation, too, the posture during defaecation should be regulated, and should be as near ‘squatting’ as possible. Approximation to this position can be artificially arranged with our modern closets by placing a footstool to raise the feet about half the height of the seat.

Active exercise, especially of the abdominal muscles, stimulates peristalsis. This can be obtained by such exercises as golf, rowing, riding, bowls, and other pursuits, such as cross-country walks. Abdominal massage, following the line of the colon, is often useful, and has the advantage that it can be done by the woman herself, when recumbent with her legs drawn up. If there is no obstructing pelvic tumour and no ballooning of the rectum by previous injury to the pelvic floor, or by the presence of a rectocele, these measures, with the stimulus of a ‘dinner-pill’ such as the following, will often cause daily bowel-action without discomfort:

Ext. Nucis Vom.	gr. ½
Ext. Bellad.	gr. ¼
Ferri Sulph.	gr. i.
P. Ipecac.	gr. i.
Aloini	gr. ½

M. ft. pil. i.

To be taken after food three times a day.

If a stronger pill is required to be taken only once a day, after breakfast or at bedtime, the addition of one or two grains of phenolphthalein (purgen) makes an excellent combination.

Many women, especially after the menopause, get satisfactory bowel-relief and lessened ‘flushings’ by taking an ounce or two of a mineral purgative water in warm water before rising. The same water should not be taken continuously for more than a few months. Sometimes liquid paraffin may greatly improve constipation.

As temporary expedients to get the bowel free of scybalous masses, rapid evacuation may be secured by castor-oil, or by three or four grains of calomel followed by a drachm of Epsom salts every hour till the bowels freely act. This is particularly useful on the third or fourth day after an abdominal operation, if a full enema has not caused the bowels to act. In such a case, especially if the bowels are distended with flatus, excellent results may follow a hypodermic injection of 1 c.c. of a 20 per cent solution of pituitrin (infundibular extract), the muscle of the bowels being strongly stimulated, with the result that a free escape of flatus and faeces often occurs in less than half an hour. Eserine (physostygminae salicylas), given hypodermically in doses of $\frac{1}{100}$ grain, is also very useful in acute abdominal cases as a powerful stimulant of intestinal peristalsis, and should be used if the pituitrin has failed to relieve. Among other useful routine purgatives for women may be mentioned pil. colocynthidis et hyoscyami gr. v; the infusion of 8 to 15 senna pods; phenolphthalein (purgen) (gr. i to iii) with ext. bellad. (gr. $\frac{1}{4}$); cascara; compound liquorice powder.

In most cases of acute pelvic inflammation the attack will be shortened and pain lessened if the bowels are kept open daily by means of a simple mixture of cascara and sulphate of magnesium, with an occasional dose of calomel, instead of keeping the patient under the influence of opiates, and it is certainly better to do this than to alternate the use of opiates with strong purgatives every two or three days. In such cases, enemata and rectal injections of glycerine are useful preliminaries to a course of purgatives.

Accessory local measures for relief of constipation beyond abdominal massage may be named. Rectal enemata of a pint or two of soap and water with two or three teaspoonfuls of glycerine or olive oil and one or two teaspoonfuls of turpentine passed up into the upper part of the descending colon by a long rectal tube, will dislodge scybala and encourage peristalsis.

One teaspoonful of glycerine injected by a suitable syringe into the rectum will often excite such reflex action that all the flatus and faecal contents of the descending colon are evacuated in 3 or 4 minutes.

(*b*) **Tonics.**—Tonics of all kinds may find a place in the treatment of pelvic disorders. Iron is well borne in nearly all cases, and should be given almost always with purgatives, otherwise it is often inert. In cases of anaemia and chlorosis, with scanty or absent catamenia, it may be combined with arsenic and freshly prepared acetate of ammonia (p. 783) or may be given in the colloidal form (liquor ferri dialysatus).[1] The perchloride of iron is far the most reliable drug in cases of a septic nature, as in sapraemia and septicaemia, and even in such cases as peri-uterine inflammations, where the septic element is not so obvious. It must be given in 15 to 30 drop doses every three to four hours. In cases of hypertrophic endometritis iron is sometimes ill borne unless the vascularity of the uterus be simultaneously lessened by ergot.

Arsenic is valuable especially when leucorrhoea, due to a chronic passive catarrh of the vagina or cervix, is present in anaemic girls.

Quinine, which has a special tonic action on the uterine muscle, is a useful adjunct, especially if given with dilute hydrobromic acid; and in cases of debility or irritability of the involuntary muscles of the body it is usefully combined with strychnine or arsenic and some sedative, such as belladonna, hyoscyamus, or bromide of potassium.

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[1] L. Dimond, M.B., *Lancet*, June 7, 1913, p. 1585.

It is obvious that no tonics should be given if dyspepsia is present, or if the liver is inactive or the tongue foul. Probably the best combination in such cases would be a few doses of mistura gentianae cum soda and appropriate purgatives.

(*c*) **For the relief of pain, e.g. Dysmenorrhoea.**—Opium, or morphia, especially by hypodermic methods, should be avoided in gynaecology more than in any other condition, except in a temporary emergency in acute cases, chiefly because the pain, as in dysmenorrhoea, is liable to recur, and the drug tends then to become habitually taken, but also because, in gynaecology, pelvic and constitutional neuroses are very common, and pain is badly borne and exaggerated. To kill the pain by opiates merely masks the symptoms, and prevents scientific treatment for the removal of the cause. For similar reasons alcohol is contra-indicated.

As a prophylactic to so-called ‘spasmodic’ dysmenorrhoea the patient’s general health should be treated, and much good is often done by giving her liq. ammonii acetatis ʒii thrice daily for two or three weeks previous to the period, adding bromide of potassium gr. x to xv to every dose for the previous week.

For the actual relief of pelvic or dysmenorrhoeal pain, aspirin is often useful in doses of ten grains every four hours. It has the advantage of making the skin act more freely and of encouraging sleep. The addition of 1 per cent solution of trinitrin (♏ i) relieves any true uterine or tubal spasm very quickly. The coal-tar products — phenacetin, ammonol, phenalgin, antipyrin (phenazone)—act much in the same way as aspirin, but are more likely to cause cardiac depression, and should therefore always be given (if at all) with carbonate of ammonia and two or three grains of citrate of caffeine.

Apiol, the active principle of common parsley, in doses of 5 minims in perles or capsules, is useful in dysmenorrhoea both with scanty menstruation in anaemic girls and where there is menorrhagia; hydrastis canadensis, best given in the form of tincture of hydrastis (B.P.) (♏ 20), or ext. cannabis indicae (gr. $\frac{1}{6}$) or tannate of cannabin (gr. $\frac{1}{2}$) combined with heroin (gr. $\frac{1}{12}$), often relieve the pain of an associated dysmenorrhoea and menorrhagia better than the coal-tar products. In all such cases the addition of bromide of potassium to lessen hyperaesthesia is advantageous. Guaiacum resin (gr. v to x) in cachets, thrice daily after food, begun three days before the expected period, often entirely prevents pain, especially in rheumatic or bilious women.

In cases of recurring intermenstrual pain (Mittelschmerz) frequently associated with sterility (Kelly) and apparently due to many different causes, such as fibroids, salpingitis, vaginal cysts, drugs seem often useless, but thyroid extract has acted like a charm in two cases where no organic cause could be discovered. Pituitrin makes the pain worse, so does ergot, whilst aspirin and bromide of potassium and trinitrin combined lessen the discomfort. These therapeutic results point to spasm or contraction of a muscular organ, perhaps of the uterus or of the tube, as being the cause of the pain. The worst case seen by me was cured by the removal of an elongated vaginal cyst, clearly a distended Gartner's duct, though the pain had been always in the ovarian region.

(*d*) **Irregular Menstruation. Drugs useful in delay, or absence, of Menstrual Periods.**—Apart from pregnancy, which is not here considered, these cases are usually of constitutional origin, especially in anaemic young women. In addition to giving them such a mixture as—

℞	Ferri et Ammonii Citratis	gr. vii.
	Liq. Ammonii Acetatis	ʒii.
	Tr. Calumbae	♏ xx.
	Liq. Arsenicalis	♏ iii.
	Aq. Chlorof.	ad ℥i.
		M. ft. haustus,

to be taken thrice daily after food, together with such purgatives as may be indicated, it is particularly useful to discover the date when the period is normally due, or if this is unknown, arbitrarily to fix a date, and give the patient twelve pills of—

℞ Potassii Permanganatis, gr. iii.
Unguenti Kaolin, q.s. ut fiat pil.

one to be taken after food thrice daily beginning two days before the date fixed. This undoubtedly stimulates the menstrual flow without doing any harm, and without in any way interfering with an early pregnancy should a wrong diagnosis have been made.

Drugs useful in Menorrhagia.—In any such case the treatment is to remove the local or constitutional cause (*e.g.* alcoholism), but if this is impossible recourse must be had to drugs or palliative measures, or to a curettage or a more radical operation if these fail or are inapplicable. Uterine haemostasis can be secured by drugs which cause tonic uterine muscular contraction, such as ergot, and by other drugs which act upon the vascular system, such as hydrastis and adrenalin. Ergot, of course, also raises the general blood-pressure, and acts much as hydrastis in this respect. In some cases both ergot and hydrastis cause digestive disturbances.

In addition to absolute rest in bed with the foot of the bed raised, the following is a useful prescription pending full investigation when the patient is seen for the first time:

℞	Acidi Sulphurici Dil.	♏ xxx.
	Quin. disulph.	gr. ii.
	Ext. Ergotae Liq.	ʒi.
	Magnesii Sulphatis	ʒi.
	Aq. Chlorof.	ad ℥i.
		Ft. haustus.

To be taken after food thrice daily.

Hydrastis Canadensis, *Cannabis Indica*, and *Apiol*, where dysmenorrhoea is also present, have been already (p. 782 *et supra*) mentioned. In such cases ergot usually increases the dysmenorrhoea, and may have to be discontinued.

Styptol (cotarnine phthalate) in ¾-gr. doses and *Stypticin* (cotarnine hydrochloride) in ½-gr. doses are both allied to hydrastine, and as they do not induce uterine contractions, and are to some extent sedative, they are very useful if dysmenorrhoea is associated with the menorrhagia.

C. Lockyer[1] is strongly in favour of styptol in tablet form (doses 0·05 grammes (¾ grains), three to five tablets daily). He quotes Vieth as saying that after absorption into the blood, styptol causes constriction of the urino-genital vessels only, no general rise of blood-pressure resulting. Others, however, have described a lowering of the general blood-pressure. It is especially useful for the menorrhagia of young girls, and in cases of fibromyomata, in pelvic inflammatory conditions associated with chronic metritis and endometritis, and in menorrhagia if associated with dysmenorrhoea, or where pain or discomfort of any sort is also present.

Chloride of calcium, or better still lactate of calcium, in doses of 10 grains thrice daily is very useful in unduly prolonged periods, its action being to increase the coagulability of the blood. Sir Almroth Wright advises that it should only be used for three days at a time, but I have found more benefit derived from beginning it a week before and continuing throughout the period.

(*e*) **Drugs useful during the Menopause.**—The conditions most usually met with are due to systemic, portal, and visceral congestions with hyperaesthesia of both the spinal and sympathetic cutaneous and visceral nerves. In addition to saline purgatives and cholagogues, exercise, non-stimulating and non-alcoholic diet, much relief is afforded by bromide of potassium in ten-grain doses thrice daily. I have not found much relief follow the administration of ovarian or lutein extract (see pp. 788 and 789).

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[1] Cuthbert Lockyer, "Styptol bei Uterusblutungen," Separatabdruck aus dem *Zentralblatt für die gesammte Therapie*, xxv. Jahrgang, Heft 12, 1907.

Artificial Menopause.—If both ovaries are removed by operation in a woman who has menstruated up to that date, the sudden onset of menopause-neuroses may cause much discomfort, especially in young women. The symptoms may last for two or three years. ‘ Flushings ’ are the most marked phenomena, but pelvic neuroses are not infrequent. Some of these neuroses may be due to irritation or suppuration round infected sutures, and if there is a vaginal discharge, especially after panhysterectomy, careful examination should be made for an infected or perhaps a partly detached suture with a sinus leading up to it.

(*f*) **Drugs, etc., useful in Dyspareunia.**—Apart from local causes of this condition, all of which would require local treatment, good is done by lessening the woman's general and local hyperaesthesia by bromide of potassium internally, and cocaine vaseline (gr. x to ℥i) locally applied to the vaginal orifice ten minutes before coitus.

(*g*) **Drugs in Urinary Affections.**—It is useful to give hexamine (gr. 5-7) twice daily after all operations where a catheter is being used, to prevent cystitis, which may primarily be due to putrefactive organisms, but sooner or later usually develops into *Bacillus coli* infection. This is especially important if vaginal gauze-packing has been necessary, as after some cases of vaginal hysterectomy, or in any case where vaginal discharges are septic. Hexamine is especially useful in acute cases of *Bacillus coli* cystitis, such as may occur after operations. It can then usually be depended upon to cure the condition in two to three weeks, without an auto-vaccine being used. In chronic cases of long standing, it relieves the toxic phenomena of the condition but does not destroy the *Bacillus coli.* If the catheter is continued in a case of post-operative cystitis, opportunity should be seized of washing out the bladder with a concentrated solution of boric acid, leaving a few ounces in the bladder after each irrigation. Occasionally a continuous irrigation with a weak boric acid solution through a double silver catheter affords great relief to pain, especially if there is much tenesmus and the urine is markedly purulent.

I have but little faith in buchu, sandal-wood oil, pareira, copaiba, methylene blue, etc., for these cases of post-operative cystitis, but I have sometimes found salol (phenyl salicylate), in doses of seven grains thrice daily in cachets, succeed in curing a cystitis and relieving pain where urotropine has failed. If the numbers of *Bacillus coli* do not diminish, or if pus or pyrexia persists, vaccine-therapy becomes essential. An auto-vaccine should be therefore always prepared from an early specimen in case it may be required.

(*h*) **Miscellaneous Drugs.** *Perchloride of Mercury and Arsenic* are useful in chronic metritis with or without haemorrhage, and this may be explained by cases reported by Louise M'Ilroy[1] and Beckwith Whitehouse[2] tending to show that such sclerotic conditions as are found in chronic metritis and fibrosis uteri are often of syphilitic origin.

A useful pill in such cases is the following:

℞	Hydrargyri Perchloridi . . .	āā gr. $\frac{1}{20}$
	Acidi Arseniosi	
	Aloini	gr. $\frac{1}{5}$
	Ext. Hyoscyami . . .	gr. $\frac{1}{4}$
		M. ft. pil. i.

S.—To be taken two or three times daily after food.

Chloride of Ammonium, again, is a drug which relieves chronic pelvic congestion quicker than any other, if it is due to hepatic engorgement or congestion. It should be given continuously for two or three weeks with an occasional calomel purge, or with Plummers' pill (pil. hydrarg. subchlor. comp. gr. v) every night for a week or ten days.

(*i*) **Hypodermic Administration of Drugs.**—Many drugs the uses of which in gynaecology are mentioned in this article, can be most advantageously administered hypodermically.

The combination of morphia sulphate (gr. $\frac{1}{4}$) and atropine sulphate (gr. $\frac{1}{120}$) given before an abdominal operation lessens shock, enables less anaesthetic to be used, and ensures restful sleep or quiescence afterwards. Some operators prefer to add to this combination hyoscine hydrobromide (gr. $\frac{1}{100}$), but it is a drug liable to affect some individuals adversely, and is better omitted as a routine procedure.

If the pulse of a patient either before, during, or after an operation becomes rapid and soft, not solely from loss of blood, a hypodermic of digitalin (amorphous) and strychnine sulphate (āā gr. $\frac{1}{100}$) will prove very useful, and if there is distinct shock during or after an operation pituitary (infundibular) extract, $\frac{1}{2}$ to 1 c.c. injected intramuscularly, acts very promptly, and as it also stimulates the uterus to contract and encourages intestinal peristalsis it is particularly useful if these secondary results are also desired. If pituitrin is injected for these latter purposes and fails to relieve, eserine (physostigminae salicylas) (gr. $\frac{1}{100}$) should be promptly given, and will often succeed in relieving flatulent distension of the bowel and sometimes give copious bowel-relief when all else has seemed to fail.

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[1] *British Medical Journal*, 1913, vol. ii. p. 1002.

[2] *Proc. Roy. Soc. Med.* (*Obst. and Gynaecol. Sect.*), vii., 1914, p. 121.

Trinitrin (gr. $\frac{1}{100}$) given hypodermically is also quite useful in shock, especially if there is spasmodic uterine pain, or if asthma or angina pectoris is also present. It also will give wonderful relief in some cases of spasmodic dysmenorrhoea. It acts like amyl nitrite but more slowly and for a longer period.

Ergot preparations are frequently used hypodermically. Perhaps the strongest of all is ergamine (gr. $\frac{1}{65}$) (β iminazolethylamine), one of the two *amines* contained in ergot, producing intense uterine contraction and rise of blood-pressure. It is not often used but deserves careful trial. Ergotinine citrate (gr. $\frac{1}{100}$) is very useful in passive uterine haemorrhage, and can be usefully combined with strychninae sulphas ($\frac{1}{20}$ gr.).

Ergotoxine (like ergamine, not often used) is the pure alkaloid of ergot, and makes the uterus contract and raises blood-pressure by its vaso-motor action. It is mainly used in doses of $\frac{1}{100}$ gr. to check post-partum haemorrhage, and has been used with some success in the passive haemorrhage of puberty.

(*j*) **Colloidal Metal Therapy.**[1]—It is probable that after the experimental stage has passed, colloidal metals may be proved to be very useful as remedies in local or even in general infections. It has been found that when pure metals are reduced to an extremely fine state of division, the particles, visible only through an ultramicroscope, are found to be in active motion, and whilst remaining harmless and non-irritant to the tissues, acquire strong germicidal properties, partly by encouraging phagacytosis but also by quickly destroying all bacteria with which they come into contact.[2] The preparation of colloids of gold, silver, platinum, mercury, and iron (liquor ferri dialysatus) has recently been improved upon, and it is not unlikely that they will be found useful in many gynaecological troubles, such as pruritus pudendi, bacillus coli cystitis, vaginitis due to infection by bacillus coli, streptococci, pneumococci, gonococci, or staphylococci, as well as in primary chancres, etc.

Metal colloids also allay vulval pain, itching and irritation of germ-origin. Injections of colloidal copper and selenium are stated to relieve the pain of malignant disease, with less constitutional disturbance than morphia. Such injections, whether into muscles, veins, or the spinal cord, appear to cause no ill-effects.

Amongst the colloidal metals colloidal iodine may in gynaecology come to hold a prominent place. A colloidal iodine has been formed where minute particles of free iodine are held in suspension and remain entirely undissolved. It is probable that colloidal iodine applied to the endometrium, vagina, and urethra may enable its germicidal action to be fully utilized, but that only can be tested by future investigation when methods and dosage are elaborated.

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[1] *Brit. Med. Journ.*, Feb. 3, 1912, p. 252 (leading article).

[2] *Ibid.*, H. Crookes, March 2, 1912, p. 521.

Some have called these colloidal metals 'metallic ferments' or 'artificial enzymes,' from the resemblance of some of their properties to the numerous organic ferments or enzymes which are all colloidal substances.

Colloidal metals are prepared by at least two distinct processes—chemical and electrical, and advocates of each claim greater stability and reliability. It is probable that colloidal metal-therapy, both for local and constitutional infections, will in the not distant future be largely utilized.

(*k*) **Organo-Therapy. Glandular Extracts.**—*Adrenalin* applied locally is useful in perineal and vulval operations where local oozing is disadvantageous, and in the haemorrhages of carcinoma uteri. Twenty or thirty drops of a 1 per 1000 solution added to a sub-mammary injection of normal salt-solution is very useful where shock due to haemorrhage is present.

Thyroid Extract is particularly useful in nocturnal incontinence of urine in children and young girls, and in such different conditions as obesity, dysmenorrhoea and 'Mittelschmerz,' in some cases of menorrhagia, in constitutional amenorrhoea to stimulate calcium excretion from uterus,[1] in recurrent carcinoma, and at the menopause. It is used empirically, there being no recognized method of physiological chemistry to certify that the patient's thyroid formation is deficient. Thyroid can be given as thyroideum siccum (British Pharmacopeia, 1914) grains ½ to 4 in cachets, or as tabloids. A useful dose with which to begin treatment is 1 grain thrice daily.

Pituitary Extract.—The functions of the anterior and posterior lobes of the pituitary gland are supposed to be antagonistic, but nothing is known with certainty. *Pituitrin*, which contains the active principles of the infundibular part of the gland, causes uterine contraction, and raises blood-pressure, and has been used in emergency to lessen uterine haemorrhage where shock is also present. I have used it freely in a case of amenorrhoea, due to acromegaly, where the blood-pressure was only equal to 121 mm. of mercury, but the relief was only occasional and partial. The dose of the 20 per cent extract is ½ to 1 c.c. injected intramuscularly.

Ovarian substance has occasionally proved useful in menopause-flushing, or after operations where the uterus and ovaries have been removed, but it has been often disappointing, and not nearly so generally useful as bromide of potassium. Ovarian substance is usually given in 5-grain tabloids, beginning with one tabloid and increasing to 4 or 5, twice or thrice daily. The same applies to the more exclusive lutein extracts which I have tried, though some have found them useful in the normal, as opposed to the surgical, menopause. Lutein extract seems to have its best use in gynaecology in encouraging menstruation when scanty in young girls, but even here it is usually disappointing or irregular in its action.

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[1] Blair Bell, *Brit. Med. Journ.*, 1909, vol. i. p. 597.

III. Local Therapeutical Measures

(i.) **Heat and Cold.** (*a*) *External Applications.*—Cold will excite reflex local contractions in both voluntary and involuntary muscle. In vigorous persons it increases the exhalation of carbonic acid. The effect of cold, externally and suddenly applied, is well seen in its application to the abdomen to cause uterine contraction in post-partum haemorrhage; or to the skin of the new-born child to excite diaphragmatic movement. The reflex effect of cold upon distant glandular organs is less well understood; but we know that cold locally applied, temporarily checks glandular secretion—a check to be followed in health, by a reactionary period of augmented secretion.

Heat, if moderate, is sedative; but if great, may excite muscular contraction, as does extreme cold, producing this effect with less shock to the individual. Hot baths are mainly sedative, relaxing the skin and its glands, dilating peripheral vessels, and thus relieving congestions of internal viscera; they are useful, therefore, in congestive dysmenorrhoea, prolapsed ovary, and the like, and are very soothing to the flushings, the restlessness, and the irritability of the menopause. They also relieve muscular spasm and nerve-tension, and are therefore found serviceable in spasmodic dysmenorrhoea, and in cases of uterine, tubal, intestinal, hepatic, and renal colic.

Bier's Hot-Air Method.—Active hyperaemia by means of hot air as applied by Bier's method[1] or by the electric heat bath (p. 800) is especially useful in peri- and parametritis to relieve pain, to shorten an acute attack, and promote absorption of the inflammatory exudate.

Hot foot- and sitz-baths act somewhat similarly. In the bath, blood is drawn from the internal organs to the surface and to the legs; these baths are therefore useful in relieving pelvic congestion, and in cases where the catamenia have been suddenly arrested by 'a chill.' Mustard added to such baths increases these effects.

Poultices and fomentations, as regards both their utility and action, may be considered as local baths. If a sedative effect be required, belladonna or opium may be added to the fomentations ; if a stimulating effect, turpentine may be added. If the local relaxation produced by a poultice be not wanted, a pad about a foot square can be made by sewing up some bran in quilted flannel. This can be put into the oven and applied dry, or may be kept hot by a Leiter's coil, or by electric heat. By dipping this bran-pad in very hot water it becomes a very light and ready poultice.

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[1] Bier's *Hyperaemic Treatment*, by Meyer and Schmieden, 2nd ed., 1909, p. 64 *et seq.*

Heat or cold can be usefully applied along the spinal column. Thus ice-bags applied to the lower dorsal and lumbar regions in cases of arrested menstruation, by partially paralysing these vaso-motor nerves, and so causing dilatation of the pelvic vessels, encourage a freer pelvic circulation. Hot applications to the same region are, by analogous action, useful in checking menorrhagia. Leiter's coils, which are now not often used, fulfil these objects admirably ; and the water can be regulated and kept at any given temperature either by the addition of ice to the reservoir of water, or by a spirit-lamp under it; and cooling can be increased or lessened by the rate at which the continuous stream of water is allowed to pass through the tubes of the coil. The pliability of the coil allows it to be moulded to any part of the body, and if the tubes be made of aluminium their weight is trifling. For reducing temperature, a coil can be moulded to the back of the head, and iced water allowed to run through it. For rallying a patient suffering from shock, heated coils applied to the feet, on the chest, and under the arms answer admirably. If moist heat be required to imitate a poultice, cloths wrung out of warm water can be wrapped round the hot coil.

(*b*) *Internal Applications. Douches.*—Some women, in perfect health, are in the habit of douching daily to ensure cleanliness ; this is not only unnecessary but does harm by interfering with the normal vaginal bacteria which are intended to resist vaginal infection by pathogenic organisms. Douching is useful once a month in married women after the menstrual flow has ended, but should only be used as a daily routine if a pessary is being worn, or if there is leucorrhoea or other discharge, especially if offensive, or irritating as in malignant disease.

Whilst in a bath, water can be made to enter the vagina by means of a grilled speculum (Fig. 296). The more usual means, however, is a douche apparatus. In all cases the flow into the vagina should be continuous—not intermittent, as when a hand-ball enema is used—and from an elevated supply of water, as from a suspended douche-can, or from an elevated syphon arrangement ; if cleansing alone be needed, two or three pints of water are sufficient ; but for relief of local congestion, 'irrigation' is employed, and several pints are used for twenty to thirty minutes. The value of this procedure, however, is probably over-estimated.

The vaginal nozzle should be of toughened glass or rubber, capable of being easily sterilized. The patient should lie flat on her back with the pelvis raised on a bed-bath. For the mere application of heat, all that is necessary beyond these points is that the temperature of the water should be properly regulated. In prolonged douching for relief of congestion, lukewarm water (95° to 105° F.) is indicated ; but for arrest of haemorrhage, or the production of muscular or vascular contraction, a temperature of 118° F. is required. Extremely cold water will also check haemorrhage, though it will not promote coagulation of the blood ; it is, however, obviously unsafe to employ it, as it may unduly check secretion, or prevent the menstrual flow from appearing if due.

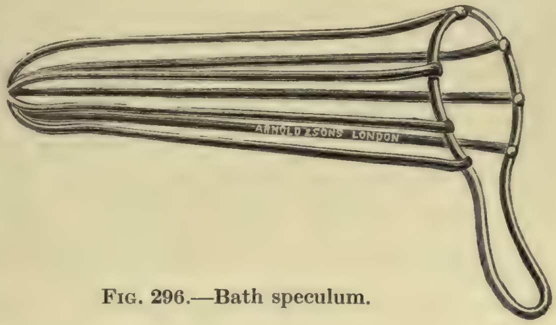

Fig. 296.—Bath speculum.

It must be remembered, however, that in addition to the thermal properties of the vaginal douche, it also has a very well-marked mechanical action. This is best obtained by so elevating the douche-can as to make the continuous current of water somewhat forcible, and capable of ballooning the vagina. This action raises the uterus with its appendages and the other pelvic contents, empties engorged lymphatic vessels, glands, and distended veins, and gently stretches, and perhaps promotes the absorption of chronic inflammatory thickenings. This ballooning of the vagina can be increased by further elevation of the reservoir, or by the patient arresting the outflow of the water from the vagina by hand pressure on the vulval orifice. By the addition of medicinal agents the douche can be rendered antiseptic.

Douches are a very convenient way of applying medicaments to the vagina. If used for antiseptic purposes, as may be required before operation, lysol (ʒj to pint), or perchloride of mercury in the proportion of 1 to 2000 or 4000 may be used ; or if prolonged use be needed, carbolic acid (1 in 100), or tincture of iodine (ʒi to pint), or borax or boric acid or izal may be substituted in the same proportion. Condy's fluid and sulphocarbolate of zinc are also useful. Creolin or lysol (1 in 200) is more suitable before a vaginal operation, when it is important that the vagina should be soft and supple ; most of the other antiseptics render it temporarily unyielding and contracted. For adequately sterilizing the vagina before operations it should be swabbed out with 2 per cent iodine-solution. Douches can be made sedative by means of the addition of liq. plumbi subacetatis (ʒii to Oiij) laudanum, or liq. opii sedativus (ʒj to Oj), chloral hydrate (gr. xx to Oj), borax or bicarbonate of soda (ʒij to Oiij), or Condy's fluid well diluted. Of astringent preparations, alum, sulphate of zinc, and tannin (in the proportion of half a drachm to the pint) are the best.

(ii.) Medicinal Agents applied to (*a*) the Skin; (*b*) the Vulva; (*c*) the Vagina; (*d*) the Uterus.

(*a*) *The Skin.*—Counter-irritation to the skin may be applied in a variety of ways, by such drugs as cantharides, mustard, turpentine, liq. iodi. fort., croton oil, and others in ordinary use. They all lessen pain and tend to check the spread of inflammation, and also to promote absorption of inflammatory exudations. These results are probably brought about by influencing the vaso-motor nerves; by stimulating the skin, they lead also to its increased vascularity, and presumably to a relatively diminished vascularity of subjacent tissues. It is clear, too, that there is some distinct action upon the terminations of the nerve-filaments from the spinal cord; and for this reason counter-irritants should be applied over the position where the same nerve-trunks, which supply the inflamed organs, send branches also to the surface of the skin. These areas, as Head has shown, are not necessarily at the site of greatest pain, but where the touch of a blunt point like a pin's head detects hyperaesthesia. It is found that these areas are supplied by the posterior roots of the same nerves which also send sensory nerves to the inflamed viscera. Thus the ovary, when inflamed, causes referred pain and cutaneous tenderness along the tenth dorsal area; the nerves going to inflamed Fallopian tubes are particularly associated with the eleventh and twelfth dorsal segments, so also are the nerves supplying the upper parts of the cervical canal and the internal os; the lower part of the cervix is related to the third and fourth sacral areas. It is difficult, of course, to estimate the curative effect of counter-irritants in those cases where rest in bed is a coincident factor in the treatment, but wherever possible these two means should be associated.

(*b*) *Applications to the Vulva.*—Ointments, lotions, fomentations, and baths have each their appropriate usefulness. If the vulva alone be affected, especially in young children, baths form the best means for applying sedative or stimulating lotions. Milk is a useful addition to the bath-water.

(*c*) *Applications to the Vagina.*—Medicaments may be applied to the vagina in many ways. Among them may be mentioned injections, douches, tampons of prepared wool or gauze, pessaries made up with cacao butter or gelatine; or applications, in the form of ointment, powder, or solution, may be made to definite areas of the vagina through a suitable speculum (pp. 792-795).

Medicated pessaries can be used for all purposes. Absorption is slow and imperfect through the vaginal mucous membrane, and at least double the usual dose of a drug should be thus administered. Only those drugs are thus used which are known to have a local effect. They are best combined with gelatine or with cacao butter, the latter being itself very soothing. The drugs most often used as sedatives are cocaine (gr. ij), morphia (gr. j), extract of belladonna (gr. ij), henbane extract (gr. v), hemlock extract (gr. v). Astringent pessaries should be made up with cacao butter; hazeline, alum, and tannin are the agents most used.

If it is desired to relieve vaginal congestion, or to encourage secretion from the vagina, a pessary of glycerine (ʒiss) combined with gelatine (ʒss) is very efficacious. This agent has one of its most useful applications as a preliminary to rapid dilatation of the cervix, the nurse being directed to introduce the pessary up to the level of the cervix two hours before the operation. If desired, drugs may be added to these pessaries to make them antiseptic or sedative, and it is in this form that ichthyol (♏iij in each pessary) has its most useful sedative and absorbent application.

Tampons may be employed to plug the vagina, or lightly to pack it ; but they are sometimes used as a convenient method of applying medicinal preparations to the walls of this passage. For this purpose gauze is easily applied saturated with various ingredients, such as carbolic acid, eucalyptus, iodoform, mercury salts, salicylic acid, sanitas, or thymol ; or plain gauze previously dipped in the desired drug, such, for instance, as a 4 per cent solution of ichthyol and glycerine, may be used. Cotton-wool likewise, tied into convenient sizes, may be used, and can be obtained saturated with boracic acid or iodoform, or contain perchloride of mercury, eucalyptus, iodine, carbolic acid, or salicylic acid or bismuth. Wool-tampons can be saturated with astringents, such as alum or tannin, either mixed throughout the wool or rolled up inside it. Wool-tampons steeped in glycerine may be used instead of glycerine pessaries, and are beneficial where the uterus needs support and depletion at the same time.

Vaginal Tamponnade.—If it be desired to elevate the uterus, to keep the cervix forwards or backwards, or merely to rest the uterus after some operation in which it has been much drawn out of position, or in which adhesions to other viscera have been broken down, there is no need to pack the vagina very tightly ; but this is very desirable where there is severe uterine haemorrhage, though it is a much more certain haemostatic procedure to plug the uterine cavity itself.

If the vagina is to be packed for haemorrhage it should first be disinfected, and the rectum and bladder should be emptied. The patient should lie in the Sims' position, and a duckbill speculum (Fig. 297) should be passed. A piece of antiseptic gauze should be inserted into the cervical canal, and the pouches around the cervix should be firmly packed with gauze ; a piece should also be laid over the cervix.

Pieces of wool rolled up into cylinders about as large as the first thumb-joint should then be passed up and pressed firmly against this roof of gauze, and the vagina completely filled; the strings attached to the wool tampons should be allowed to hang out of the vagina. As a rule, they should be left in for twenty-four hours, and it will generally be found that the haemorrhage has been arrested, coagulation occurring in the upper gauze-layers.

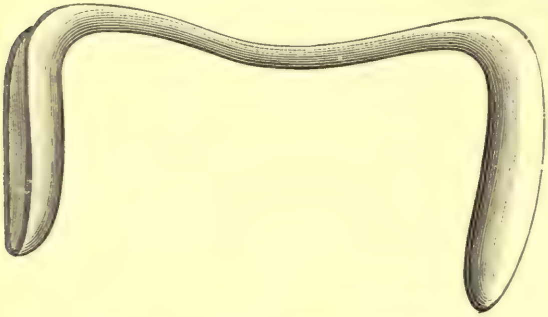

FIG. 297.—Sims' duckbill speculum.

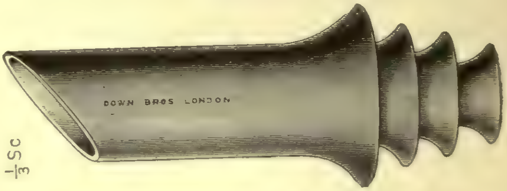

FIG. 298.—Fergusson's speculum. (Four sizes.)

Direct applications of drugs can be made through a speculum to any affected area of the vagina. The best specula for the purpose are a duckbill (Fig. 297) or Fergusson's mirrored glass one (Fig. 298), or Kelly's cylindrical metal one with stout handle (Fig. 299), or a dilating speculum such as Allingham's (Fig. 300). Nitrate of silver up to a strength of gr. x to ʒj, or an 8 per cent solution of sulphate of copper, is useful in some inflammatory conditions due to gonorrhoeal and septic infections. In cases of inoperable new growth or malignant ulceration pure carbolic acid, chromic acid, acid nitrate of mercury, bromine dissolved in spirits of wine (1 in 4), are all

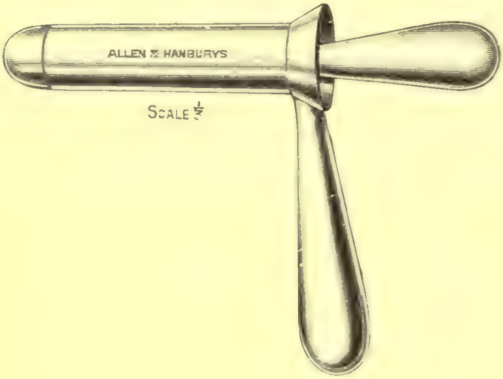

FIG. 299.—Kelly's metal vaginal speculum.

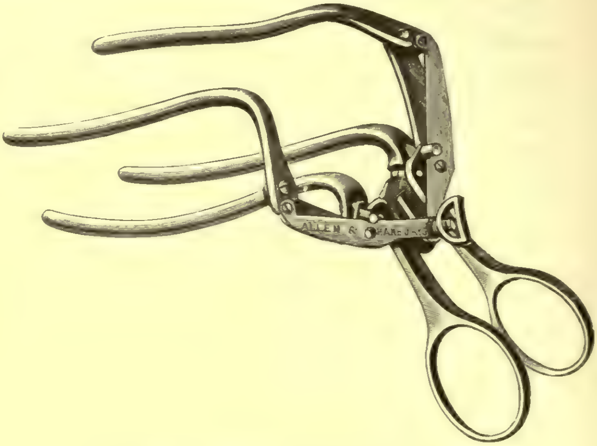

FIG. 300.—Allingham's vaginal speculum.

useful, with appropriate precautions, but radium emanations should now in all such cases be tried first (p. 843). It is in all such cases useful to digest unhealthy sloughs by means of wool or gauze soaked in glycerine of pepsin. It makes the surfaces clean, and removes foetor and discharge.

(*d*) *Applications to the Uterus.*—Medicaments used for the vagina may also be employed for the vaginal portion of the cervix, but more care is required for intra-uterine applications.

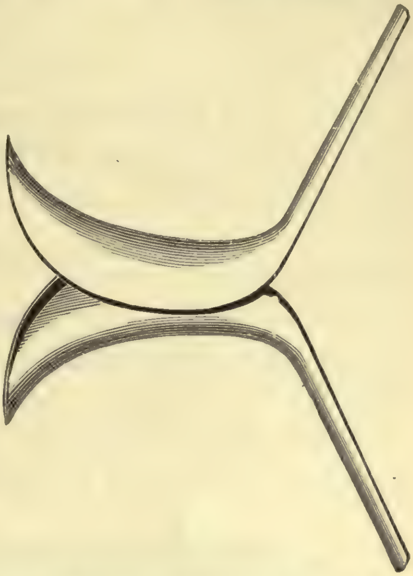

FIG. 301.—Neugebauer's diverging speculum.

To apply substances to the endocervix, it must be exposed by a speculum, such as Kelly's (Fig. 299) Fergusson's (Fig. 298), or a duckbill speculum (Fig. 297), or Neugebauer's diverging speculum (Fig. 301). After the cervix and endocervix are wiped free from mucus, the solution, or powder, should be applied on a probe, such as Playfair's, armed with cotton-wool. The substances most used are acidum carbolicum liquefactum, iodized phenol,[1] liquor iodi, iodine paint[2] or Churchill's solution of iodine,[3] liquor ferri perchloridi, and ichthyol (4 to 10 per cent solution). Another good method is to pour down a Fergusson's speculum a solution which can be encouraged to enter the cervical canal freely by means of an armed probe. One of the best solutions for this purpose is an 8 per cent solution of sulphate of copper. If there be much congestion, the cervix should be first punctured till it has assumed a light-pink colour, and if Nabothian follicles are present they should be punctured also. These are cases which are very suitable for Bier's suction glasses (p. 799).

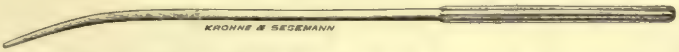

FIG. 302.—Playfair's probe with longitudinal grooves (see footnote, p. 796).

Where the endometrium is extensively inflamed, or is the seat of adenomatous overgrowth, dilation and curetting become necessary; but there are many milder inflammatory conditions of the endometrium in which a cure can be obtained by several careful applications of one or other of these, or other, drugs to the cavity of the uterus. They are best used through a Fergusson's speculum, and should be carried into the uterus on a Playfair's probe[1] (Fig. 302) suitably curved. The cervix should be exposed and cleansed, and the uterine curve should be ascertained by a careful bi-manual examination, or if necessary by a sterilized sound.

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[1] Iodine 1 part, and liquid carbolic acid 4 parts.

[2] Iodine, iodide of potassium, spirits of wine and water, equal parts (Samaritan Free Hospital).

[3] Iodine, 78 grains; iodide of potassium, 90 grains; rectified spirits to 1 ounce.

If this curve be acute, the cervix should be held and drawn down by Teale's forceps (Fig. 303), or Sims' tenaculum (Fig. 304), to straighten the curve; and if any constriction is found to exist, a few of the smaller sizes of such bougies as Fenton's (Fig. 305) should first be passed, or Palmer's dilator (Fig. 306) used, for uterine colic is thereby prevented and good drainage facilitated. All instruments employed in the above technique are boiled in an electric sterilizer before use.

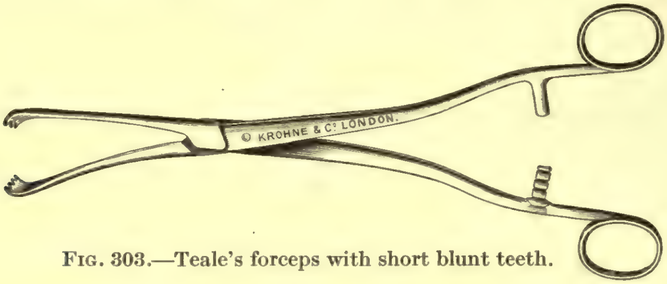

Fig. 303.—Teale's forceps with short blunt teeth.

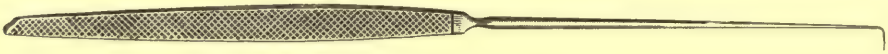

Fig. 304.—Sims' tenaculum.

If convenient, these measures should be taken when the patient is in bed, in some hyperaesthetic cases even anaesthetized, and able to be at rest for some hours. After the application, if the patient is anaesthetized, it is useful to pass into the uterus, above the level of the os internum, a thin strip of gauze or lint, soaked in iodine and glycerine, to ensure a watery discharge and free drainage. It should be removed in twelve hours, and an antiseptic douche given.

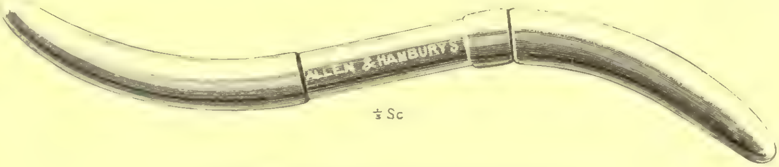

Fig. 305.—Fenton's cervical dilator.

Intra-uterine injections should never be used without previous dilatation of the cervix to secure free exit of the fluid, especially when a flushing curette is employed. Spasm of the cervix and sudden uterine contraction constitute a real danger during the irrigation of undilated uteri, for it must be remembered that occasionally the Fallopian tubes remain unduly patent as a result of disease, or as part of a general pelvic subinvolution.

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[1] The best variety of Playfair's probe has not a bulbous end, but tapers slightly, and the wool, though held sufficiently firmly not to come off when the probe is withdrawn, will come off readily enough afterwards without scissors if the serrations on its surface are longitudinal. It should be made of aluminium (Fig. 302).

(iii.) **Accessory Measures:** (*a*) **Blood-letting**; (*b*) **Bier's Suction Method**; (*c*) **Catheterization.**

(*a*) *Blood-letting.*—Sometimes it is desirable to relieve congestion by the local abstraction of blood. This may be done by applying leeches, by puncturing, or scarifying; or the same result may be arrived at by the abstraction of blood-serum, as when blisters are applied, or when glycerine tampons are introduced into the vagina, or by Bier's suction glasses (Fig. 307).

Thus *leeches applied to the perineum* relieve pelvic congestion by depleting the superior, median, and inferior haemorrhoidal vessels coming from the inferior mesenteric, internal iliac, and internal pudic arteries respectively; between all of which there is free anastomosis. Relief is thus afforded to the portal as well as to the general system, as the superior haemorrhoidal vein belongs to the portal, while the middle and inferior belong to the general venous system. Marmaduke Sheild has drawn attention to the relief afforded to vesical and pelvic congestion and irritation by the application of leeches or counter-irritation to the inside of the thighs. This he accounts for partly by vaso-motor influence, but mainly by the depletion of the capillaries fed by the pudic branches of the femoral, relieving thus the area of congestion by lowering the blood-pressure in the branches of the internal pudic (from the internal iliac), with which they freely anastomose.

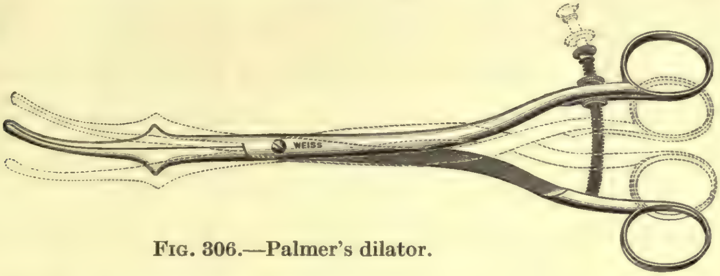

FIG. 306.—Palmer's dilator.

Blood may be abstracted from the cervix by the application of leeches, by puncturing or scarification. Blood thus drawn relieves the whole pelvis. The cervix is mainly supplied from the uterine arteries, but these anastomose so freely with the ovarian and vesical arteries that the relief becomes very general. The vagina should first be douched with some warm antiseptic solution, such as borax (ʒij to Oiij), the patient being in bed in a warm room. In cases of congestion of pathological origin, with marked blueness of the cervix, instantaneous relief is afforded by puncturing it and the abstraction of two or three drachms of blood. The cervix becomes and remains pink, which shows that the circulation, which was stagnant, is restored. Puncturing is done by exposing the cervix in a speculum, rendering the surface as aseptic as possible, and then with a long-handled sharp-pointed knife gently stabbing the vaginal aspect of the cervix. These stabs should be very slight at first, so as to indicate the tendency to bleed; they may then be increased in depth and number till the loss is considered sufficient. Cross cuts (scarifying) may be employed instead of these punctures, or as an addition to them. The cervix should then be painted with liquor iodi, and a glycerine pessary or tampon inserted if it is desired to increase the serous discharge. If much congestion be present in cases of endocervicitis or endometritis, a preliminary puncturing is advisable before applying remedies to the lining membrane.

(*b*) *Bier's Suction Method*[1] of producing active hyperaemia and of encouraging escape of discharges has been successfully used in cases of infective chronic endometritis and metritis, to induce menstruation in some types of amenorrhoea, to improve drainage of purulent and muco-purulent discharge from the uterus and vagina in ulcerations or severe erosions of the cervix.

Bier's suction of the cervix is stated to be particularly useful in some cases of posterior perimetritis and in parametritis, by causing intense hyperaemia of the cervix and free discharge from its glands; pelvic pain of obscure origin and long duration has yielded to this method.

The apparatus is simple (Fig. 307). A transparent glass speculum, closed externally, shaped like a large test tube, is used; near the closed end is a fenestrated nozzle to which a rubber tube and suction pump is attached. After careful sterilization the open end of the suction-glass is passed over the cervix as far as the vaginal attachment. Gentle suction is then made as directed by Bier, the amount of hyperaemia resulting from the suction, and the amount of discharge withdrawn being visible through the suction-glass, to which a reservoir extension (Fig. 307) may be added to collect what comes away. If the suction-glass is applied after puncturing the cervix, or after Nabothian follicles have been punctured, much greater relief is afforded.

Bier recommends that the suction-glasses should be applied for five minutes at a time, repeated six times after intermissions of three minutes. Only moderate painless suction is needed.

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[1] Bier's *Hyperaemic Treatment*, by Meyer and Schmieden, 2nd ed., 1909, p. 184.

(*c*) *Catheterization.*—Every one now adopts some measures of surgical asepsis in this procedure, but it is imperative that the technique should be thorough to be effective. Even then, however, one has to deal with germs in the urethra itself, such as *Bacillus coli,* which may render catheterization dangerous, especially if required on several consecutive days.

Not only must the patient's genitals, and the doctor's or nurse's hands be sterilized, but sterilized gloves or finger-and-thumb stalls should be used. The catheter and all accessory appliances should also be sterilized. The catheter should be of glass, and six or eight inches of rubber tubing should be added. With the patient lying on her back, with her knees drawn up and rolled out, the labia should be widely separated with one hand, and the vestibule and adjacent parts, including the external meatus urinarius, *gently* disinfected with wool soaked in weak carbolic or lysol solution. The catheter is then taken between the finger and thumb and allowed to find its way with gentle pressure into the bladder. It is important to collect the urine which comes away towards the end of the bladder-evacuation in a second receptacle, for it may give evidence of residual urine, or may contain an excess of blood- or pus-cells.

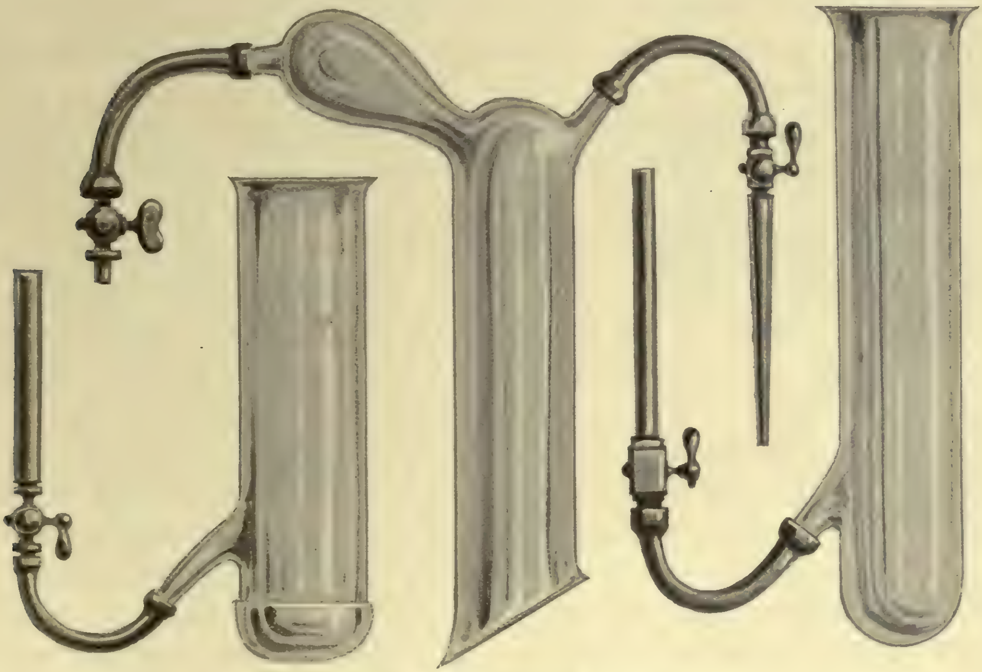

Fig. 307.—Bier's suction glasses for the cervix uteri.

IV. ELECTRICITY IN GYNAECOLOGY

Electricity was but little used in diseases of women till 1886, when Apostoli published his first five years' experience of the use of strong continuous currents in the treatment of fibroids, chronic metritis, sub-involution, and peri-uterine inflammation. Thomas Keith, C. H. F. Routh, and Milne Murray did much to further these methods. Ten years ago the present writer dealt with the subject in Allbutt, Playfair, and Eden's *System of Gynaecology*, and though he described the varied electrical methods then in use, he fully realized that surgical methods of treatment, such as hysterectomy, curettage, etc., had largely superseded Apostoli's electrical procedures.

Now the surgical pendulum appears to be again swinging downwards, and less radical therapeutics are tending to take its place. It does not seem, however, that electricity will ever resume the position it held between 1890 and 1900, though some of the allied discoveries which have been made since, or have arisen through its use, seem likely to be largely utilized, such as radium rays, Röntgen rays, and high-frequency currents. It was hoped that the ultra-violet rays of the spectrum might be utilized, but it is now known that these rays do not penetrate the skin, and Ironside Bruce does not think they will prove useful.

Faradization by the induced current is still sometimes used for the relief of pelvic pain, but only where patients are unable to get relief by drugs or refuse surgical methods. It is possible that it is not used enough for such troubles as coccygodynia, or for true pelvic neuralgias, or for promoting absorption of chronic pelvic inflammatory exudation.

Therapeutic Uses of Electric Heat and Light Baths.—Although the idea of radiant heat was originated by Kellog of Michigan, U.S.A., Polano was the first to systematize the treatment of chronic inflammatory pelvic exudations by means of heat generated by electricity. Bier had previously advised similar treatment with heat derived from other sources. It can be carried out by placing the patient undressed in a prepared cabinet with the head alone outside, so that the air inspired is normal. The heat and light is supplied by ten or twelve incandescent lamps of 16 candle-power arranged in rows. An apparatus can be improvised which fulfils the purpose admirably for bedridden patients, by fixing the lamps along the framework of an ordinary bed-cradle enveloped in mackintosh and blankets, but the best cradle is made of wood lined with aluminium (Fig. 308). It is then applied over the abdomen and pelvis, and has certainly hastened the absorption of parametric exudation in chronic cases. The more locally it can be applied the more efficacious it proves.

It should be applied daily for thirty minutes. Ironside Bruce states that the number of lamps and their candle-power is a matter of individuality, but high temperatures are not essential. There is no advantage in using red lamps, but they must have carbon filaments to give the desired heat.

Therapeutic Uses of High-Frequency Currents and Diathermy.—These rapidly interrupted induced currents are known to be able to relieve local pain and to have powerful tonic effects upon the system, and to increase the individual resistance. They also have a definite local action in reducing vascularity. I have seen granular bleeding piles cured, temporarily at all events, by means of vacuum electrodes (Fig. 309) in patients who objected to local applications or operative treatment. They also have a strong germicidal action, and Ironside Bruce has cured chronic cases of *pruritus pudendi* by these means.

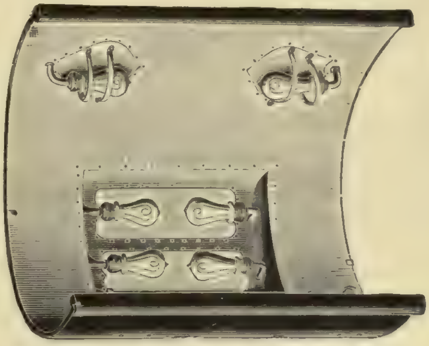

Fig. 308.—Abdominal frame for electric light and heat.

Diathermy is also useful for the destruction of small vascular growths. I recently had a patient who had been passing blood with her urine for some months. Finding the blood was from the bladder, I sent her to J. Swift Joly, who found a benign papillomatous growth broadly attached near the orifice of the left ureter about the size of an almond, but shaped like a cock's comb. He applied high-frequency currents on four occasions, by puncturing the polypus by means of an electrode carried through the catheter-channel of a catheterizing cystoscope, manœuvring the point till it lay in contact with the tumour. The other pole was connected with a pad on the abdomen, and the current was turned on for ten or fifteen seconds five or six times at each sitting. No pain was caused by this proceeding, for pain is stated by Joly to be always an indication that the spark is acting on normal tissues. The polypus was completely destroyed after the fourth sitting, and the patient remains well. The currents act by producing heat-coagulation in the tissues through which they pass, while the electrode itself remains cold. When a small electrode is used the action is so intense that the tissues are destroyed. The term 'fulguration' is used when high-frequency currents are used to destroy tissue. The terms 'diathermy' and 'electro-coagulation' are also used. Probably similar results would follow high-frequency currents in cases of mucous polypi of the cervix, and they are said to be successful for vascular caruncle of the urethra. I should imagine, too, that it would be useful in those intractable cases of more or less continuous uterine haemorrhage which sometimes come on in girls at puberty. Such cases often do not improve under any general or local treatment, and hysterectomy has been advised and in a few cases actually carried out to save life. If such a case were really severe I should not hesitate to advise a series of exposures to high-frequency currents by means of a vaginal vacuum electrode (Fig. 310).

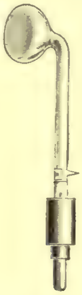

Fig. 309.—Vacuum electrode for high-frequency currents. (Suitable for haemorrhoids.)

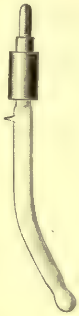

Fig. 310.—Vaginal vacuum electrode for high-frequency currents.

Nagelschmidt[1] advises diathermy in cases of cancer of the cervix before hysterectomy.

V. Balneo-Therapeutics

Such a large subject as this can only be very briefly outlined, but the following remarks and table will not be out of place.

There are certain health resorts and spas, at home and abroad, noted for springs of water which have been found useful in pelvic disorders. Some of the best are here tabled, but it must be remembered that it is often necessary to send a patient to a resort where the water is suitable rather to the constitutional diathesis than to the actual pelvic condition, which may be a complication. Thus anaemic patients may be sent to Levico, or Strathpeffer; gouty persons to Bath, Harrogate, Droitwich, or elsewhere.

Sea-water, again, is a very good substitute where it is not possible to go to one of the suitable resorts. Sea-water, when pure, is somewhat similar to Woodhall Spa water; it is rich in salines, bromine, and iodine; it is a powerful hepatic stimulant and purgative, and can be used advantageously internally in some cases of portal and pelvic congestion, as well as in the form of baths and douches.

The following are some of the baths which are especially useful in cases of chronic pelvic congestion, subinvolution, or fibroids, and which serve to hasten complete recovery after acute inflammatory attacks, where exudation into the uterine or peri-uterine tissues has been well marked.

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[1] *Proc. Roy. Soc. Med. (Electro-Therap. Sect.)*, 1910–1911.

TABLE OF BATHS AND HEALTH RESORTS FOR CHRONIC PELVIC DISORDERS

Names of Places and Altitudes.	Season.	Character of Water.	Special Uses.
Bex, Switzerland, 1400 ft.	May to Sept.	Saline water, bromo-iodurated.	Chronic pelvic exudations. Fibroids.
Contrexeville, France, 1000 ft.	June to Sept.	Alkaline, effervescing, 55° F.	Where acidity, gravel, or gout complicate pelvic disorders.
Plombières, France, 1330 ft.	June to Sept.	Ferruginous, 66° F. to 143° F.	Chronic endometritis with anaemia.
Royat, France, 1480 ft.	June to Sept.	Alkaline, ferruginous, and arsenical, 45° F. to 95° F.	Pelvic congestion with gout.
Salso Maggiore, Italy.	April to Oct.	Mainly chlorides of numerous metals, but the *aqua madre* contains iodine and bromine.	Uterine catarrh and chronic pelvic exudations, especially if associated with gout or rheumatism.
Vittel, France, 1000 ft.	June to Sept.	Alkaline, effervescing.	Congestion with obstinate constipation.
Woodhall, Lincoln.	May to Oct.	Saline, bromo-iodurated.	Subinvolution. Chronic inflammation. Fibroids.

It appears to be probable that emanation from the radium salts and mesothorium combinations which are found to exist in the waters of Bath, Buxton, Plombières, Aix-les-Bains, Droitwich, and other spas may explain some of their good effects in relieving pain and promoting absorption of overgrowths and inflammatory exudations.

Unfortunately the radio-activity diminishes rapidly if the waters are used away from their source, so that treatment is essential at the spa itself. Treatment at the source is advantageous for other reasons, the chief of which is the routine life, diet, and entourage of the health resort, all of which tend to suggest to the patient that good is being done by every detail of the *régime*.

VI. Vaccine-Therapy

Acute Cystitis.—In every case the infecting germ, which is usually *Bacillus coli*, should be identified, and an auto-vaccine prepared. Hexamine should be given at once, and suitable local and general measures adopted, especial attention being paid to the intestinal tract.

The initial dose of the auto-vaccine should be determined both by the constitutional condition of the patient and the virulence of the infection, and in the case of *Bacillus coli* should be between 10,000,000 and 25,000,000.[1]

The dates and the rate of increases of subsequent doses should be regulated by the reaction, and the clinical course of the attack. Until the practitioner is familiar with vaccine-therapy he should be guided on all these points by the bacteriologist. Sometimes auto-vaccines will completely cure the patient in three or four weeks; sometimes there is a symptomatic cure owing to relief of the toxaemia, but the bacilli do not become entirely absent, and exacerbations from time to time arise.

The vaccine-treatment of *chronic cystitis* is much less satisfactory, but excellent and often permanent results can be obtained by auto-vaccines if the patient be seen during an acute exacerbation, especially if all predisposing causes be searched for and removed.

Urethritis.—Gonorrhoea is the commonest cause of acute urethritis, and can then be dealt with better by abortive treatment applied to all the infected areas than by auto-vaccines.

In any case, even without treatment, gonococci soon cease to be found in the urethra, but a streptococcic or staphylococcal infection may persist in a chronic form, and here the application of pure carbolic acid usually promptly relieves. If the urethritis recurs, chronic cystitis or vulvitis is probably also present, and may need autogenous vaccines or other measures to relieve.

Vulvo-Vaginitis of Children.—This is often of gonococcal origin, and is very obstinate both as regards difficulty of cure and tendency to recur. Those who have had opportunities of comparing the effect of local applications on the one hand, and vaccine treatment on the other hand, are strongly in favour of the latter. Probably it is wise, as I have always done, to adopt both methods of treatment simultaneously, although it prevents scientific proof of their relative therapeutic value.

Salpingitis.—I have treated with auto-vaccines several cases of recurring acute gonorrhoeal salpingitis, where gonococci have been discovered in the endometrial or endocervical discharges, and sometimes with remarkable arrest of the ascending inflammation and cutting short of the attack as compared with previous attacks. These have been usually cases where the husband had occasional return of a gleety discharge, and he should be referred to a surgeon for appropriate treatment.

I have tried autogenous vaccines in chronic endometritis, where only streptococci or staphylococci were found, but with no real success, except perhaps in one case where an acute *Bacillus coli* infection of the bladder and endometrium simultaneously occurred. Even in this case the vaccine rapidly cured the cystitis, but only partly relieved the endometritis, which was cured subsequently by curettage, and iodine applications.

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[1] The general principles of Vaccine-Therapy are dealt with in the Article on Examination of the Blood (Vol. I. p. 191).—EDITORS.

Tuberculosis of the Genital Tract.—In spite of the fact that it is apparently true that tuberculous lesions of the genital tract may sometimes become spontaneously cured, it is advisable not only to treat the affected organs surgically, but to do everything to improve the patient's health, and to combat the disease simultaneously with tuberculin injections as advised by a competent bacteriologist. Such specific treatment expedites recovery and minimizes the risk of recurrence (Allen[1]), and even if the condition is inoperable cures have followed vaccine treatment. I have seen, for instance, excellent results in inoperable cases of tuberculous cystitis so long as patients were in hospital, though I do not know of a permanent cure.

I have no experience of vaccine-therapy in primary tuberculosis of the Fallopian tube, but it should certainly be adopted in inoperable cases, or after removal of all visible growth.

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[1] R. W. Allen, *Vaccine-Therapy*, 4th ed., 1912, p. 259.

RADIO-THERAPEUTICS

PART I.—RÖNTGEN RAYS IN GYNAECOLOGICAL PRACTICE

By F. Lionel Provis, F.R.C.S.E.
(London)

The treatment of gynaecological diseases by X-rays has not received the attention in this country that it has on the Continent. From experiments and clinical investigations made by Continental workers there can be no doubt that the immediate effects of such treatment in suitable cases are eminently satisfactory and can be recommended with confidence and safety. As regards remote results, it is more difficult to express an opinion, but here again, from statistics published by Continental clinicians, the outlook appears promising. In carrying out X-ray treatment of diseases peculiar to women it is essential that the gynaecologist and radiologist should work together. A gynaecologist when recommending radiotherapy to his patients, even if he is unable to carry out the treatment himself, should at least have a sound knowledge of the technique and the principles on which it is based.

General Principles

Cathode Rays.—X-rays are generated by the passage of electric currents of high potential between two electrodes placed in a highly exhausted tube. When such a tube is connected with the terminals of an induction coil there are propelled from the cathode a great number of negatively charged particles, which constitute the cathode rays ; individually, they are called electrons and consist entirely of negative electricity ; the cathode rays may be deflected from their course by a strong magnet. The velocity of these particles is very high and often reaches as much as one-third of the velocity of light, or 60,000 miles per second. Their velocity is dependent upon the electro-motive force used to generate them and on the degree of exhaustion of the tube. The greenish-yellow fluorescence of an X-ray tube in action is due to the bombardment of the cathode rays upon its walls, when the latter are made of soda glass. Should there be any lead in the glass the fluorescence assumes a bluish tint.

X-Rays.—When cathode rays are stopped in their passage by any substance such as the glass wall of the tube, or by metal placed in their path they are converted into X-rays. X-rays cannot be deflected from their path by a magnet. They are not therefore electrically charged particles as the cathode rays are. They are true rays, that is to say, true radiations or disturbances in the ether. Of the various properties of X-rays may be mentioned their power of causing fluorescence in certain substances, and their action on sensitive salts of silver which is similar to that of light, a property which has been made use of in one of the methods for estimating the dosage (Kienböck quantimeter, p. 813). They possess various degrees of penetrating power; they are said to be *soft* if they have a small penetrating power, and *hard* if they are very penetrating.

From the therapeutic point of view also, X-rays may be described as being of two varieties, the soft and hard. Soft rays are emitted from an X-ray bulb of high pressure; the harder, more penetrating rays, on the other hand, are discharged from tubes of low pressure; but it must always be borne in mind that however highly exhausted a tube may be, some soft rays are emitted from it, and as these soft rays are a source of danger to the skin, appropriate methods of filtration must be adopted.

In the treatment of deep-seated gynaecological diseases, innocent or malignant, the hardest penetrating rays possible should be administered, for in this way the deepest parts receive the most efficient treatment without subjecting the superficial structures to too intense an exposure. The improved methods of filtration, by means of which the soft rays are cut off, have led to the adoption of these very hard rays in the radio-therapy of deep-seated diseases.

The Construction of an X-Ray Tube.—Figure 311 shows the general arrangement of an X-ray tube. The *cathode* consists of aluminium and has a concave surface, which serves to focus the cathode rays to one point, and is so placed that the rays come to a point at the centre of the glass bulb. At this centre is placed a block of metal with a platinum or tungsten face, and this is known as the *anti-cathode.* Platinum is used because it has been found that the greatest quantity of X-rays is generated when the target for the cathode rays is made of this metal. Thin sheets of the metal are fused in intimate contact with a solid block of another metal, of a less expensive type, which can carry the heat off rapidly and disperse it by radiation.

Attached to every X-ray tube is some device by means of which the degree of vacuum of the tube is regulated. This takes the form of a small chamber communicating with the main chamber and containing one or more small discs of carbon, mica, or some similar substance, which, when heated, possesses the property of liberating gases. The heat is generated by the passage of an electrical current through the small chamber. Gas is thus set free which enters the main chamber and so reduces the vacuum and consequently the hardness of the tube. Another method is to attach to the tube an osmosis regulator which consists of a tube of palladium fused into a small glass chamber, communicating with the main chamber of the X-ray tube. Palladium possesses the property, when heated, of allowing hydrogen gas to pass through its substance. Therefore when the palladium is heated by some suitable means, hydrogen from the atmosphere passes into the tube, and thus diminishes the vacuum within the main chamber. The cathode of the X-ray tube is connected with the negative pole, and the anti-cathode with the positive pole of the coil.

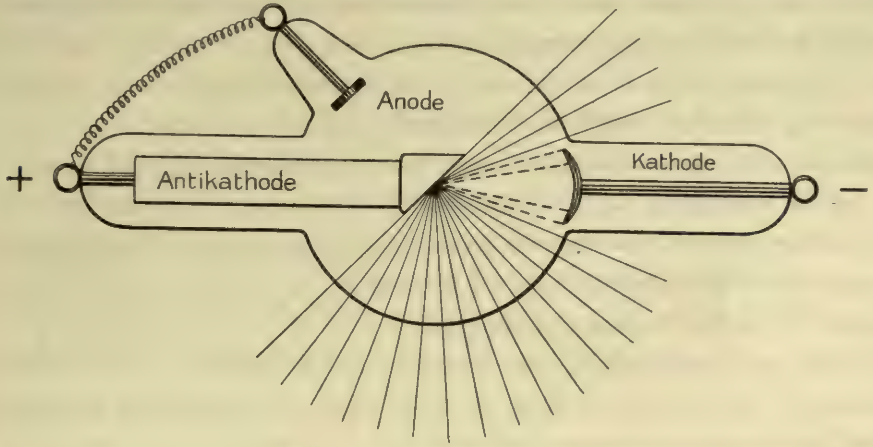


Fig. 311.—Diagram of an X-ray tube.

Production of X-Rays.—The method of generating X-rays in an X-ray tube is to pass an electric current between the cathode and the anti-cathode. To overcome the resistance of the gap between them a very high electro-motive force is required. The resistance in fact is so high that voltages ranging from 50,000 to nearly 200,000 are required according to the softness or hardness of the bulb in question. To obtain such a high voltage from the lower voltage which is used for lighting houses, etc., from the main currents, *transformers* are employed. The transformer most commonly used up to now is the induction coil. The essential parts of an induction coil capable of giving the voltages indicated are (*a*) the primary coil which consists of a number of thin sheets of a special magnetic iron, round which are wound about 100 turns of copper wire. This is placed in a stout ebonite tube to insulate it from the secondary coil. (*b*) The secondary coil, which consists of many thousand turns of copper wire carefully insulated, and wound in some 100 thin vertical sections. (*c*) The condenser, which is usually situated in the base of the coil and consists of a number of alternate layers of tin-foil and paraffin. The main functions of the condenser are to increase the intensity of the discharge through the tube and to restrict it to one direction and prevent what is known as 'reverse current.' In the course of the primary circuit is connected some form of interrupter whose function is to make and break the current in very rapid succession. When the current is made in the primary circuit, a momentary current is induced in the secondary coil, and when it is broken, a momentary current is also induced in the secondary coil, but in an opposite direction.

In X-ray work it is essential that the current should be unidirectional. The current which is induced on breaking the primary circuit has the same direction as the inducing current; the current which is induced on closing the primary circuit has an opposite direction and is called the closing or reverse current. As already mentioned, one of the functions of the condenser is to cut out this closing or reverse current, thus the sparks which pass between the terminals of the secondary coil are due mainly to the break and are unidirectional. The length of the spark-gap is used as a guide to the hardness of the tube.

Characteristics of an X-Ray Tube.—X-ray tubes are frequently spoken of as being 'soft' or 'hard.' An X-ray tube in which the pressure is high and which emits rays of a low penetrating power is designated 'soft,' as are also the rays discharged from it. On the other hand, a tube in which the pressure is low and which emits rays of a high penetrative power, is designated 'hard,' as are also the rays emitted from it. The hardness of the rays produced by an X-ray bulb is mainly dependent upon the maximum potential difference between the electrodes. The higher the pressure within the tube, the less the potential necessary to conduct the current from the cathode to the anti-cathode, and the softer or the less penetrating the X-rays produced. The lower the pressure, the greater the potential necessary and the harder the X-rays. Nevertheless, as already stated (p. 808), however hard a tube may be, some soft rays are always discharged from it along with the harder rays, and these soft rays being a source of danger to the skin require filtering out when applying hard rays in the treatment of deep-seated affections.

A soft tube in action is characterized by a bright-green fluorescence, which is due to the bombardment of the wall of the bulb by cathode rays which have been reflected from the anti-cathode, with some blue light in the darker portion of the tube behind the anti-cathode, varying in amount according to the softness. In a hard tube the bright-green fluorescence is replaced by a dirty, greyish-green, somewhat foggy appearance; there is no blue light in the region of the anti-cathode; and the tube emits a peculiar crackling sound when in action.

Penetrating Power of the Rays.—A rough estimate of hardness can be obtained by the appearance of the tube, and by measuring the length of the equivalent spark-gap (p. 819). For the more accurate estimation of the quality of the rays, certain instruments have been devised (*penetrometers*). The penetrometers based on the principle of comparing the transparency to the rays of silver with that of aluminium are the best known, and of these the Benoist, the Benoist-Walter, and the Wehnelt will be described.

The Benoist penetrometer consists of a thin silver disc 16 mm. in diameter and 0·11 mm. thick, surrounded by twelve steps of aluminium of increasing thickness; the first step is 1 mm. and the last 12 mm. in thickness. The rays are passed through the instrument on to a fluorescent screen, and the observer notes which of the aluminium steps corresponds in transparency with that of the silver disc. This having been accomplished, the number is noted, and the penetrating power of the tube is said to be that number on the Benoist scale. For example, if the aluminium step of 4 mm. thickness is found to correspond in transparency with the silver disc, it is said that the penetrating power or hardness of the tube is No. 4 on the Benoist scale.

In the Benoist-Walter penetrometer there are only six steps instead of twelve. This modification was made because it was found that no tube used for therapeutic purposes could be so hard as Nos. 10 to 12 of the original Benoist scale. The Wehnelt penetrometer (Fig. 312) is the most convenient instrument to use; it is based on the same principle as the Benoist. It consists of a sheet of lead in which a slot 5 mm. wide and 20 mm. high has been cut out, it is covered on one side with a fluorescent screen, on the other side the lower half is covered with a thin silver strip, and a wedge of aluminium 16 cm. long is so designed that it can be moved along the upper half of the slot. The thickness of this wedge measures from 1 to 11 mm. A cardboard box is fixed to the apparatus so that it can be used in daylight, and protection is afforded to the operator's face by the use of lead glass over the fluorescent screen and a metal disc attached to the radiometer (see Fig. 312). When the rays from an X-ray tube are allowed to fall on the slot, two small fields of unequal luminosity are observed. The luminosity of the field covered by the silver strip remains constant and serves as a standard. The aluminium wedge is now moved along till the two fields are of equal luminosity, and when this has been accurately adjusted the number is read off on a scale, and the penetrating power of the tube is said to be that number of Wehnelts.

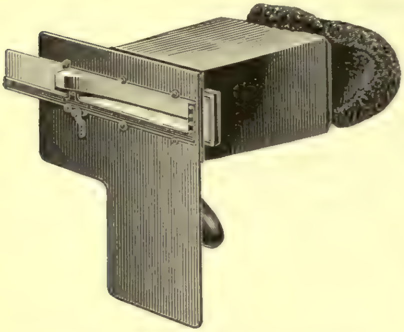


FIG. 312.—Wehnelt penetrometer.

For deep-seated gynaecological affections, tubes of a hardness of 10 or 11 degrees on the Wehnelt scale should be used. In addition to the appliances already described, every X-ray installation should include an ampèremeter, milliampèremeter, valve-tube, and oscilloscope. The ampèremeter shows the amount of current which is flowing in the primary circuit, and acting on the secondary winding of the coil. The milliampèremeter indicates the amount of current flowing through the circuit in which the X-ray tube is placed. The valve-tube serves to cut out the reverse current which tends to flow at the 'make' of the current. The oscilloscope is an instrument designed to show the presence, or absence, of any reverse current, and indicates the condition of the valve-tube.

Estimation of Dosage.—It cannot be denied that as yet we have no accurate method of estimating the X-ray dosage. At the present time there is no standardization of dosage. We are nevertheless able to estimate the dose with sufficient accuracy to avoid injury through over-exposure or failure through under-exposure.

For convenience of description the standard dose of X-rays may be described as the 'erythema dose,' an erythema dose being that dose of unscreened X-rays which will produce a slight erythema within fifteen to twenty-one days of its application.

The methods at our disposal for estimating the dosage may be divided into the indirect and the direct. The two should always be used together, as the former serves as a useful check to the latter.

In the indirect method the milliampèremeter is used to measure not the X-rays but the quantity of current passing through the tube ; the number of milliampères multiplied by the volts gives the quantity of X-rays generated in the tube. The quantity of X-rays received by the object depends on (*a*) the quantity of X-rays generated, (*b*) the distance between the tube and the object, (*c*) the time of the exposure, (*d*) the sensitiveness of this object. The reading of the milliampèremeter must therefore be supplemented by these other factors before we can estimate the dose received.

The distance has a great influence because the intensity of the X-rays diminishes as the square of the distance from the anode increases. A strip exposed 40 cm. from the anti-cathode requires four times as many milliampère seconds to assume tint 5 X as a strip exposed at a distance of 20 cm.

The presence of reverse currents may cause an under exposure, because milliampèremeters of the d'Arsonval type do not indicate alternating currents if both phases are of equal strength. If one phase preponderates the milliampèremeter indicates only the difference between the breaking and the closing current. The presence of reverse current is detected by means of an oscilloscope tube placed in circuit with the milliampèremeter.

Direct Method.—The total quantity of X-rays received upon the surface of the patient can be measured by several methods. The best known of these are the Holzknecht, Sabouraud and Noire, Kienböck, Bordier, Hampson, Christen, and others. The principle of the majority of these depends upon the action X-rays has on certain chemical substances, by virtue of which these substances change their colour. Thus the Holzknecht, Sabouraud and Noire, Bordier, and Hampson methods depend upon the action which X-rays have upon discs of barium platino-cyanide. These discs are green when new, but the dose which produces an erythema changes them to a red-brown. Sabouraud and Noire give only one tint for comparison, tint B, which represents that dose of X-rays which causes the hair to fall out, or four-fifths of an erythema dose.

Holzknecht, using the same pastilles, introduced a modification by means of which fractions of the erythema-dose can be measured. A celluloid band of red-brown colour is drawn over an unexposed pastille till it shows a colour similar to the exposed one. When the two colours coincide a reading is taken from the prepared scale. In this way fractions of the erythema-dose can be estimated.

These pastilles are not very sensitive, and to obtain a sufficiently great change in colour they have to be exposed at half the distance existing between the anti-cathode and the surface of the body, thus they receive four times the quantity of X-rays that the body surface receives. They are therefore not very adaptable for deep-seated therapeutic work. The method that will be found most serviceable for such work is that introduced by Kienböck, and is the one that has been most universally adopted on the Continent.

Kienböck estimates the dosage by a photographic process (Kienböck quantimeter, Fig. 313). He uses strips of bromide of silver paper contained in a black paper wrapper (Fig. 313, D). The strips are exposed on the skin. After exposure to the full erythema-dose the white colour of the silver paper is changed almost to black. He divides the full erythema dose, which he calls X, into ten equal parts. Half an X, *i.e.* the one-twentieth part of an erythema-dose, is the second tint on the scale, 2 X are one-fifth, 5 X one-half an erythema-dose, etc. By covering the sensitive strip with a sheet of aluminium 1, 2, or 3 mm. in thickness, it is possible to estimate the quantity administered at a depth of 1, 2, or 3 cm. below the skin, because a piece of aluminium 1 mm. in thickness absorbs as many X-rays as does a layer of skin, fat, and muscle measuring 10 mm. in thickness.

The strips have to be developed for thirty seconds in a developer of standard strength and at a temperature of about 64° F. After the bromide strips have been developed the tint of each is compared with a scale of standard tints and the quantity of X-rays administered calculated in terms of X. The advantages of this method are the acute sensitiveness of silver paper to X-rays, its accuracy, and the fact that a permanent record can be kept and recorded upon a suitable chart (see Fig. 327, p. 827).

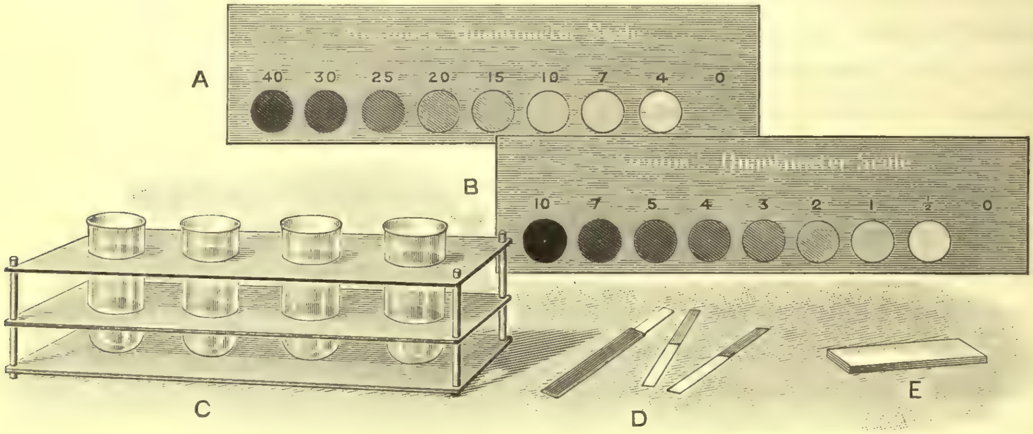


FIG. 313.—Kienböck quantimeter.
A, standard scale to be used with paper exposed under 10 mm. aluminium; B, ordinary standard scale; C, test-tubes; D, bromide papers; E, 10 mm. aluminium block.

The disadvantage of this method is that the estimation of the dose is made after it has been administered, but if before the treatment is commenced we know the number of ampères and milliampères, the duration of time, and the hardness of the tube, as gauged by the spark-length necessary to produce 10 X, we have the requisite data necessary for acting as an efficient control, provided the above-mentioned factors remain fairly constant.

Description of Kienböck Quantimeter.—The apparatus consists of: (1) Strips of bromide of silver paper measuring ½ inch by 2½ inches, enclosed in small light-tight envelopes. The envelopes bear a label to be filled up with the name of the patient, date, and duration of the exposure. Each label is numbered, and there is a corresponding number on the bromide of silver strip. (2) A standard scale in wooden case, containing eight different tints of the colours which the bromide of silver will assume gradually under prolonged influence of the X-rays. (3) A set of four test tubes of 2 inches diameter and 2 inches length in small metal stands. (4) A dark box in which the developing is carried out. This is convenient for developing a strip during treatment if necessary. It is not very suitable for developing a large number of strips; for this purpose a small, properly fitted dark room will be found more convenient. (5) Two solutions of standard strength—(*a*) the developer, (*b*) the fixer.

Development of Strip.—The developer consists of two standard solutions, *a* and *b*, which at the time of use are mixed together in equal quantities. To the mixture a variable quantity of distilled water is added, according to the instructions issued with each box of strips. The developing solution has to be used at a definite temperature (64° F.), according to the instructions, and it is important that this temperature be strictly adhered to, because a too cold developer gives a result far below the actual dose received.

The fixing solution is prepared ready for use. The four test tubes in stand are now filled, No. 1 with developing solution of proper strength and temperature, No. 2 with ordinary water, No. 3 with the fixing solution, and No. 4 with ordinary water. The strips are removed from their envelopes either in the dark box or room and immersed in the developer for thirty seconds. The strips must be kept during this time in constant motion; they are then washed for a few seconds in test tube No. 2, from this they are transferred into test tube No. 3, containing the fixing solution, in which they must remain for one minute. They are then rinsed in the fourth glass, and are now ready for comparison with the standard scale. Two strips can be developed at a time, and the same developer may be used for a large number of strips, but it deteriorates gradually with exposure to air.

The standard scale (Fig. 313, B) consists of nine different units, marked 0, ½, 1, 2, 3, 4, 5, 7, 10. The tint marked 1 is to be considered the unit and is denoted by 1 X.

In the treatment of gynaecological diseases, as also in the case of malignant diseases, very large doses are required, as much as 20 to 40 X to each area. With such large doses the strips would become too dark for comparative readings to be made, consequently a second scale has been prepared, in which tints are shown which are obtained on strips exposed under a block of aluminium 10 mm. thick.

In this way the action on the strip is lessened, and the latter does not become so dark, although large doses are given. Quantities up to 30 or 40 X can thus be conveniently estimated (Fig. 313, A).

The dose which the strip then shows is that which has been applied at the surface, and not, as is sometimes assumed, that which has reached 10 cm. depth.

TECHNIQUE

From observations made during the treatment of superficial pathological conditions, such as diseases of the skin, radiologists recognized the possibility of utilizing X-rays in the treatment of deep-seated affections. The gradual evolution of the present technique for the treatment of such affections is primarily due to the pioneer work of Albers-Schönberg, Bordier, Haenish, Krönig, Gauss, and others. The results obtained by these clinicians, each one adopting a technique of his own, were of such a striking nature that their work soon commenced to attract universal attention.

Gauss and Lembcke, working in Krönig's clinic at Freiburg, carried out exhaustive researches on the important subject of filtration, and as a result of their investigation devised an improved technique, the distinguishing features of which are the administration of massive doses through many ports of entry, the use of 3-mm. aluminium filter, and adequate protection to the skin-surface, thus enabling large doses of X-rays of high penetrating power to be administered, having a minimum effect upon the skin with a maximum effect upon the deep tissues. The Gauss and Lembcke technique, or some slight modification of it, is the one that is now most generally used.

Improvement in the manufacture of tubes and apparatus led to the use of tubes emitting rays of a high penetrating power. The various devices invented for keeping the tube cool are responsible for the increased length of time a tube can be kept running in a more or less constant state of hardness.

Of the best known techniques the following may be mentioned with a short summary of their detail.

Albers-Schönberg Technique.—Tube of a hardness 6 to 8 Walter or 8 or 9 Bauer, with a current of 2 to 3 milliampères. Distance of skin from anode 38 cms. and use of compression diaphragm. Three exposures given at each cycle to three areas on the lower abdomen. One exposure a day lasting six minutes. The whole cycle of irradiation not lasting more than eighteen minutes. An interval of at least fourteen days between each cycle of irradiation. A subsequent irradiation must be given only if the skin is quite guarded by a thick leather filter, and the X-rays filtered through a layer of aluminium or tin. Treatment extends over three to five months.

Bordier's Technique.—Tubes, water-cooled, of a hardness 8 to 10 Benoist. The bulb is always placed at same distance, *i.e.* breadth of hand from filter. Irradiation carried out in series of cycles. Each cycle comprising nine exposures of the median region of lower abdomen and the iliac regions. Three exposures each month between menstrual periods. One exposure a day—time five to six minutes; interval of three weeks between each cycle. Filtration for median area, aluminium 3·5 mm. in thickness; for the lateral ports of entry, thickness of filter varies from ½ mm. to 3 mm. The filter placed on the abdomen is connected to the earth by means of a flexible metallic wire. The dose is measured by Bordier's radiometer and records the dose of the incident rays, that is, the dose falling on the aluminium filter. The pastille is attached to the filter itself, and the dose to be given corresponds to the tint 3 of Bordier's scale, which is exactly equivalent to 5 H. The pastille is compared with the scale by the light of a match, a candle or a benzine lamp, or other artificial light of slight actinic power. Median region protected by lead during exposure of lateral regions.

Haenish's Technique.—Penetration of tube, 6 to 8 Walter, or 7 to 9 Bauer. Distance of anti-cathode from the surface of the skin, 36 cm. Water-cooled tubes are used having a current of 1½ to 2 milliampères. A filter of thick sole-leather or 1 mm. aluminium, with an addition of one or two layers of chamois leather.

Each series comprises four sittings, given on four consecutive days, preferably beginning immediately after menstruation. Each sitting lasts five to six minutes. Slight compression is used by means of the compression-cylinder and a loofah-pad. During each series a total dose of 5 to 10 Kienböck is reached. Between the series from fourteen to twenty-one days elapse.

Technique of Krönig and Gauss.—Tubes used are of the water-cooled Müller rapid variety, of 8 Bauer or 13 Wehnelt penetration, with a current of about 4 ampères in the primary, and 5 milliampères in the secondary. Filtration, 3 mm. aluminium, together with a loofah-sponge and several layers of satrap-paper. Twelve areas or ports of entry are mapped out on the abdominal wall between the umbilicus and the pubes, and each area receives 15 X (see below), all areas being exposed in rotation at one sitting, which lasts about four hours. The skin outside the area receiving treatment is protected by means of T-shaped pieces of lead 2 mm. thick. These should be covered with lint to prevent secondary-radiation effects upon the skin. Over this and covering the whole of the abdomen, with the exception of the small area being irradiated, is placed a sheet of lead-rubber 2 mm. thick. An interval of three weeks is allowed between two sittings. The number of sittings necessary to effect a cure is from three to six. No patient is considered cured till she has been rendered completely amenorrhoeic, and even after this condition has been brought about one or two more sittings are given to ensure success. Of late this technique has been somewhat modified; thus the number of ports of entry have been increased to forty or sixty, as a consequence of which the amount of rays administered has been considerably increased till the average amount of dosage of the whole treatment has reached 1475 X. The exponents of these massive doses claim the following advantages :—

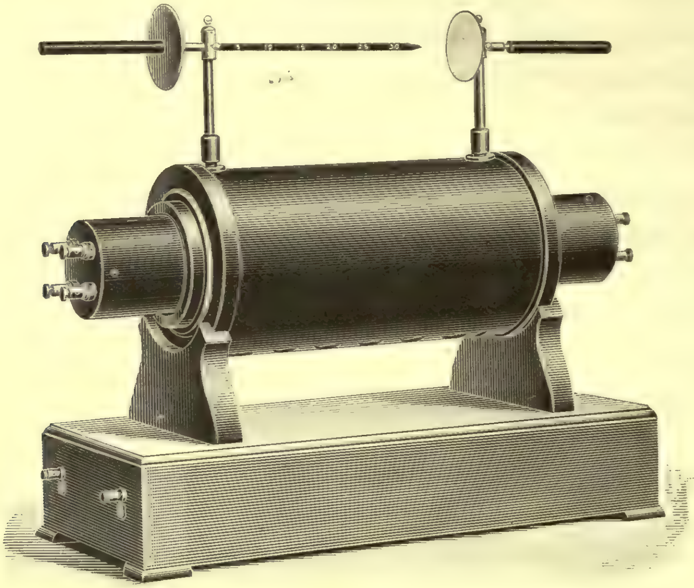


FIG. 314.—Induction coil.

(*a*) 100 per cent cures.

(*b*) Shortening of the time of treatment to an average of five weeks.

(*c*) Should the treatment fail to check the haemorrhage, and the cause of this be due to the presence of unrecognized carcinoma, no appreciable time has been lost in dealing with the disease surgically.

(*d*) Absence of any injuries to the intestinal canal, notwithstanding the massive doses administered.

Author's Technique.—The present author has adopted a technique very similar to that of the Freiburg School, the details of which are as follows :

The source of energy required to excite the tube is derived from the main current. This is transformed from a voltage of 200 to one of some 100,000 volts by means of

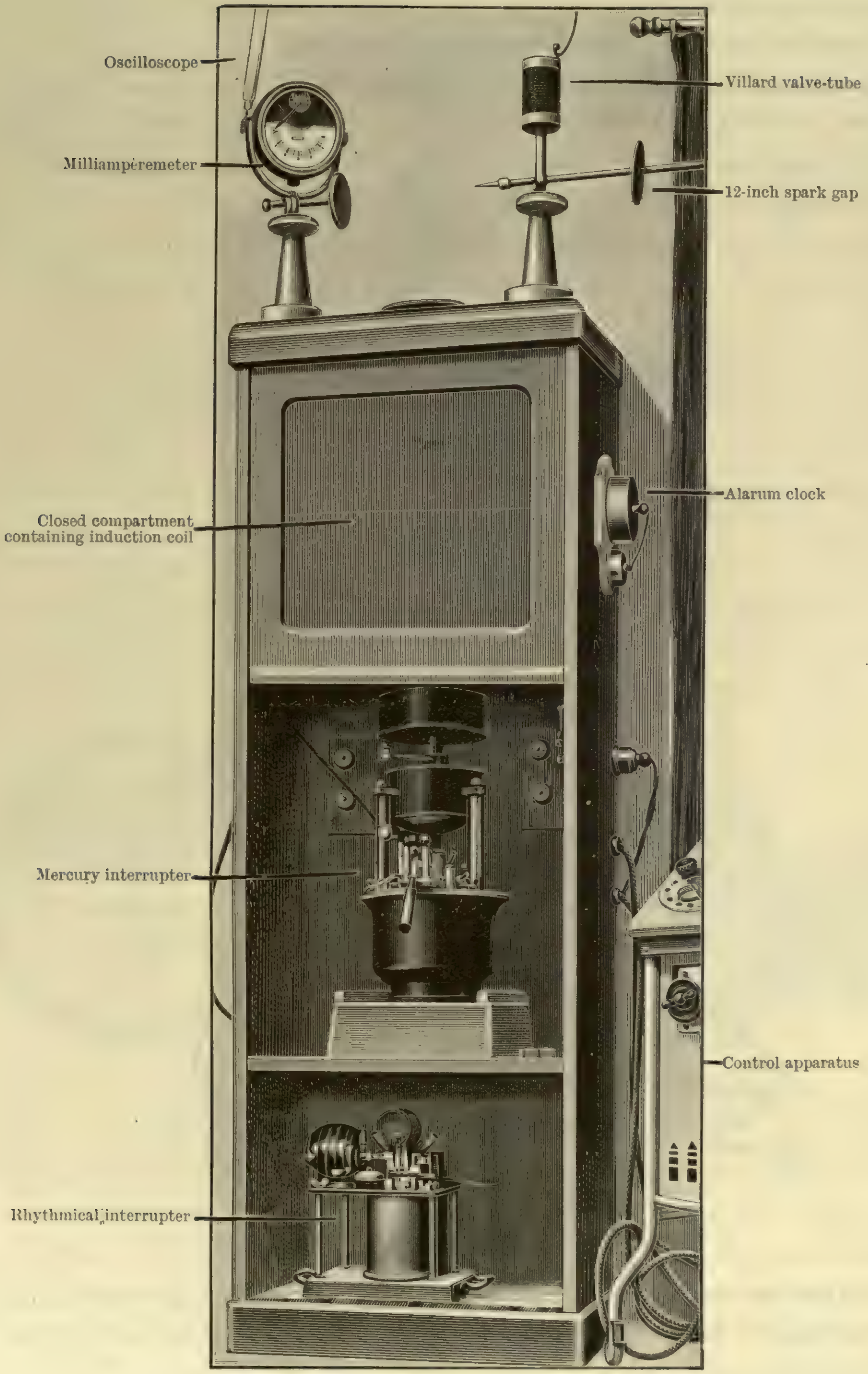


FIG. 315.—Stand containing apparatus for working X-ray tube.

a 12-inch spark (induction) coil (Fig. 314), such a high voltage being necessary to overcome the resistance encountered in an X-ray tube.

In the course of the primary circuit is connected a mercury interrupter (Fig. 315), whose function is to make and break the current in very rapid succession.

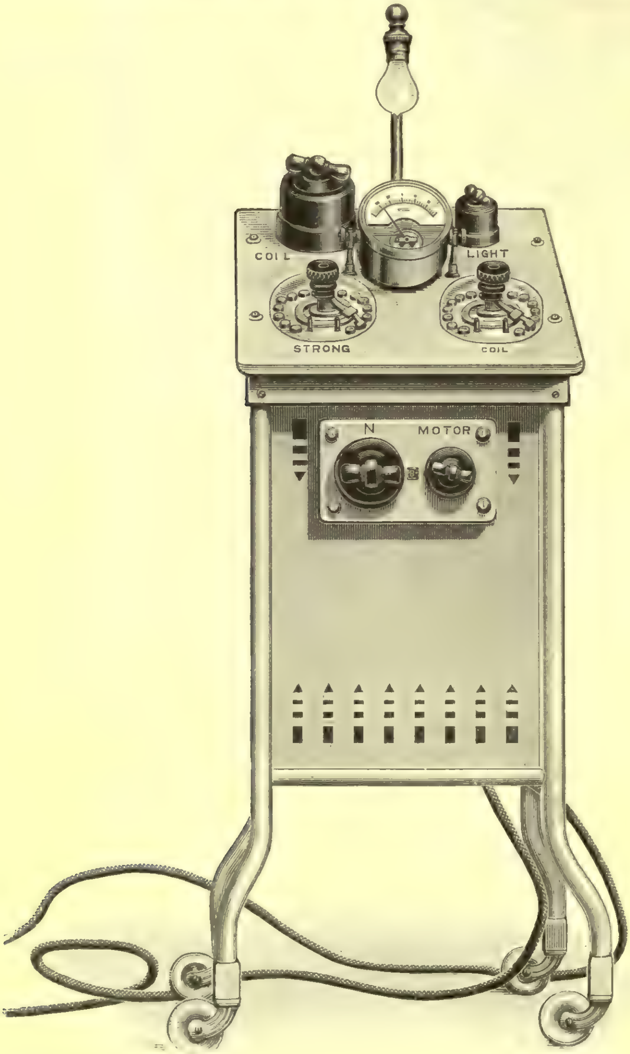


FIG. 316.—Switchboard or control apparatus on trolley.

A rhythmical interrupter (Fig. 315) is attached to the apparatus for the purpose of interrupting the current, thus allowing time for the tube to cool between the periods of activity.

In circuit with the secondary coil is a 12-inch spark-gap and a Villard valve-tube (Fig. 315) to check the reverse current, an oscilloscope (Fig. 315) to detect its presence, and a milliampèremeter to register the amount of current flowing through the circuit in which the X-ray tube is placed, shown in enlarged size in Figures 317 and 318.

The whole apparatus is controlled by a switchboard on a trolley as is shown in Figure 316. It consists of resistances to vary the speed of the mercury interrupter motor, and the amount of primary current. In addition there are switches to control these parts, and an ampèremeter to show the amount of the primary current.

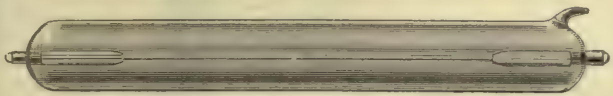


Fig. 317.—Oscilloscope tube.

The tubes used are of the water-cooled Müller rapid variety, equipped with Osmo regulators, and having a penetrating power of 10 to 11 Wehnelt, with an equivalent spark-gap of an average length of 10 inches. A 3-mm. aluminium filter is employed (Fig. 319). Figures 320 and 322 show the method adopted for keeping the tube cool by means of a continuous stream of water circulating through it. The water from the upper tank flows to the tube, and is returned to the lower tank by means of a double-channelled tube, the two channels within the tube being connected one with the upper tank, the other with the lower. When the upper tank has emptied itself the position of the two tanks is reversed, and by this means a stream of water is kept circulating through an auxiliary chamber which is in direct contact with the anode of the X-ray bulb, and thus is carried off a great proportion of the heat generated at the anode. The tube is fixed in a suitable tube-stand (Fig. 320), the box of which can be moved up and down, and fixed at any required angle by manipulation. A wire connects the tube-stand to the earth.

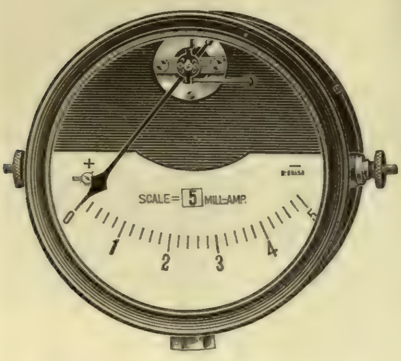


Fig. 318.—Milliampèremeter.

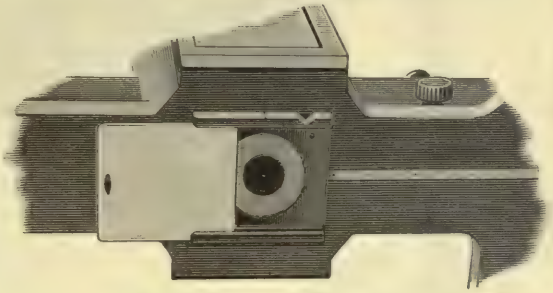


Fig. 319.—Aluminium filter.

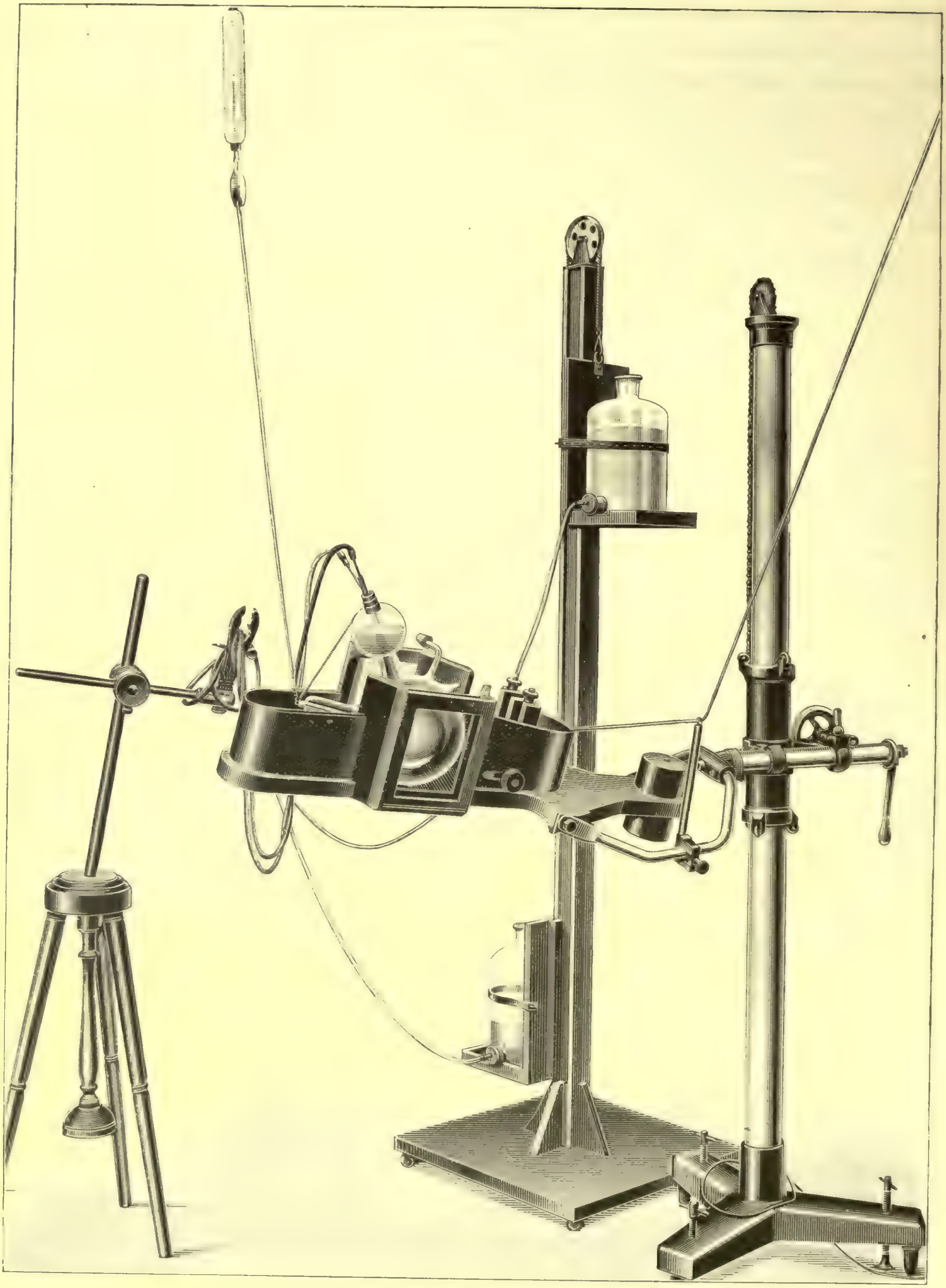


Fig. 320.—Tube in stand with water-cooling apparatus attached.

Figure 322 shows the position of patient and tube preparatory to the commencement of treatment.

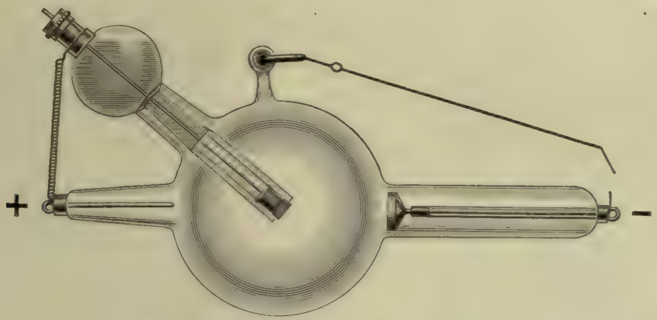


FIG. 321.—Water-cooled X-ray tube.

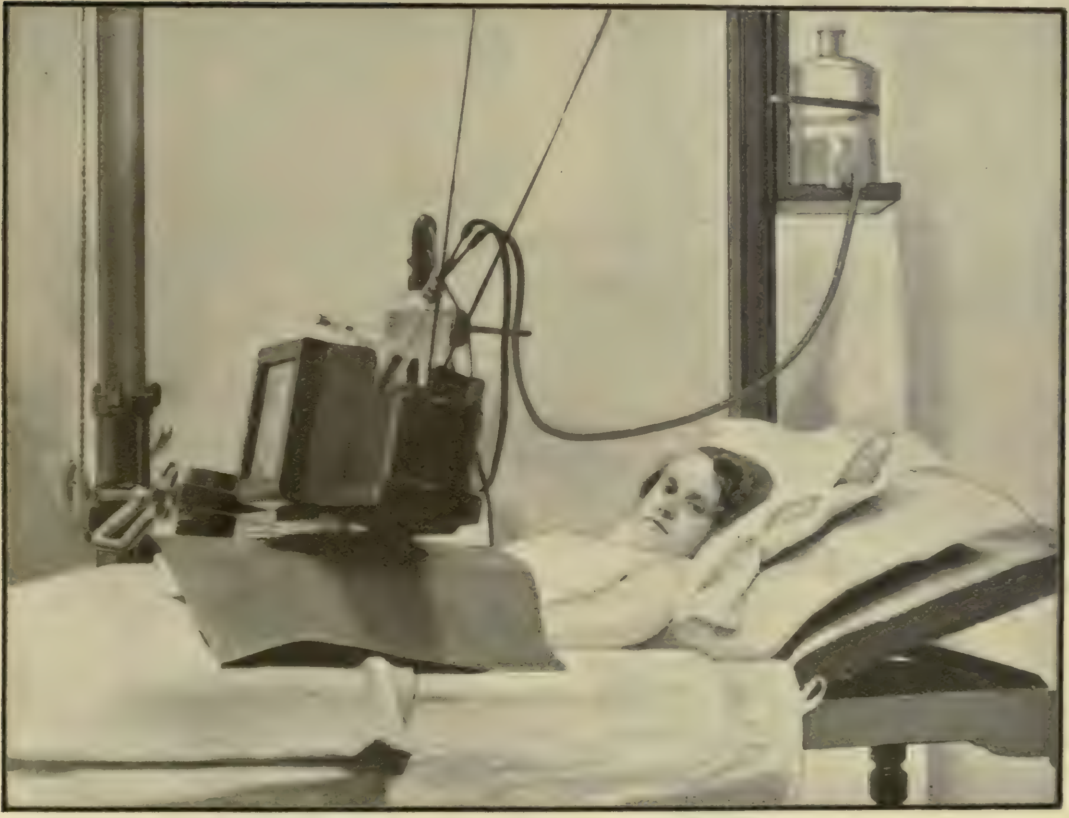


FIG. 322.—Patient and tube in position for treatment.

The patient is placed on the couch, and twelve square areas are marked out with a coloured pencil on the abdomen between the umbilicus and symphysis pubis (Fig. 323). Each area receives separate radiation and is enclosed by two lead angles (Fig. 324), which are so placed that only the field to be irradiated is left exposed. Over the exposed area is placed an additional filter composed of a loofah-sponge and four layers of satrap-paper (Fig. 325) contained within a small linen bag. In the centre of the bag is a small pocket, in which is placed the Kienböck paper (Fig. 325). The bag is so adjusted that the centre of the pocket for the Kienböck strip is placed in

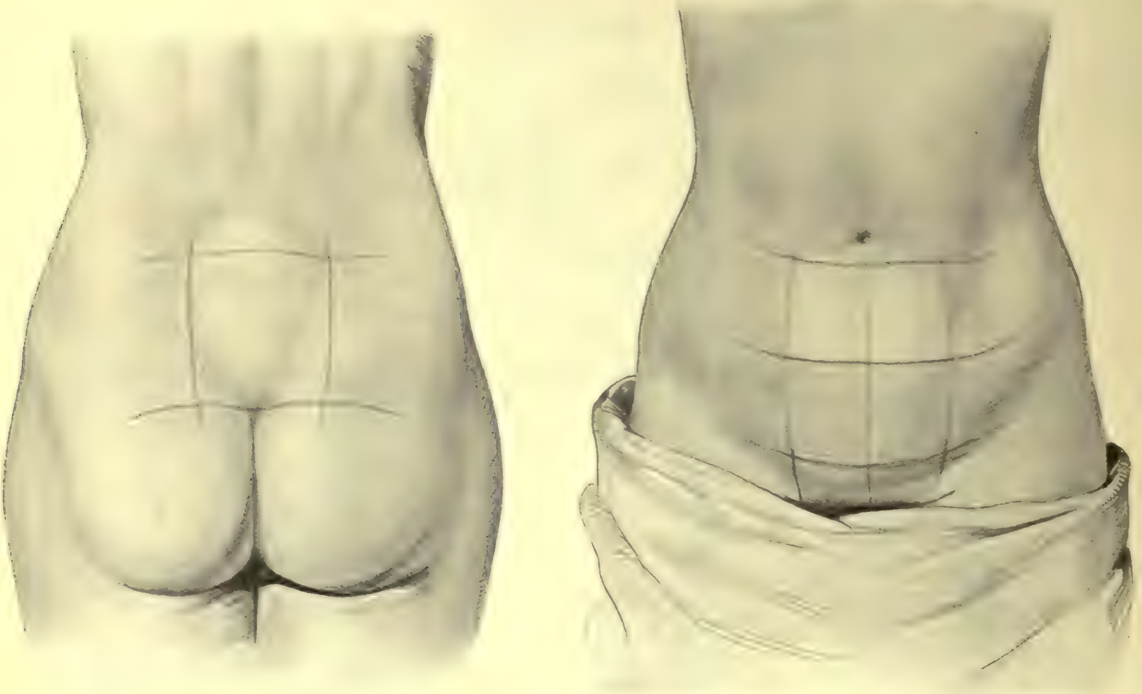


FIG. 323.—Areas mapped out for irradiation.

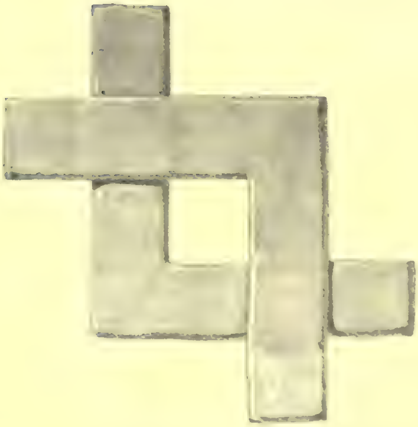


FIG. 324.—Lead squares for protecting skin.

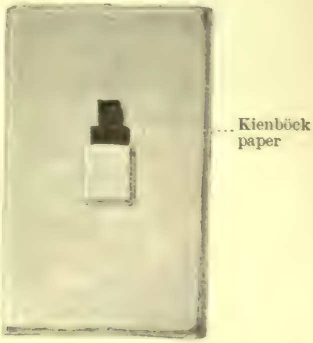


FIG. 325.—Bag containing loofah-sponge and satrap-paper, with Kienböck paper inserted.

the centre of the exposed area and rests in approximation with the skin. The whole abdomen is covered with a sheet of lead rubber, in which a square has been cut out and through which the rays pass to the exposed area of the abdomen. The tube-box is now adjusted in such a manner that the anti-cathode is in line with the centre of the square of the exposed area (Fig. 326). The box is next lowered and tilted to any required angle, and brought to rest at a point as near to the abdominal parietes of the patient as is possible. No part of the under surface of the tube-box is allowed to come in contact with the coverings of the patient.

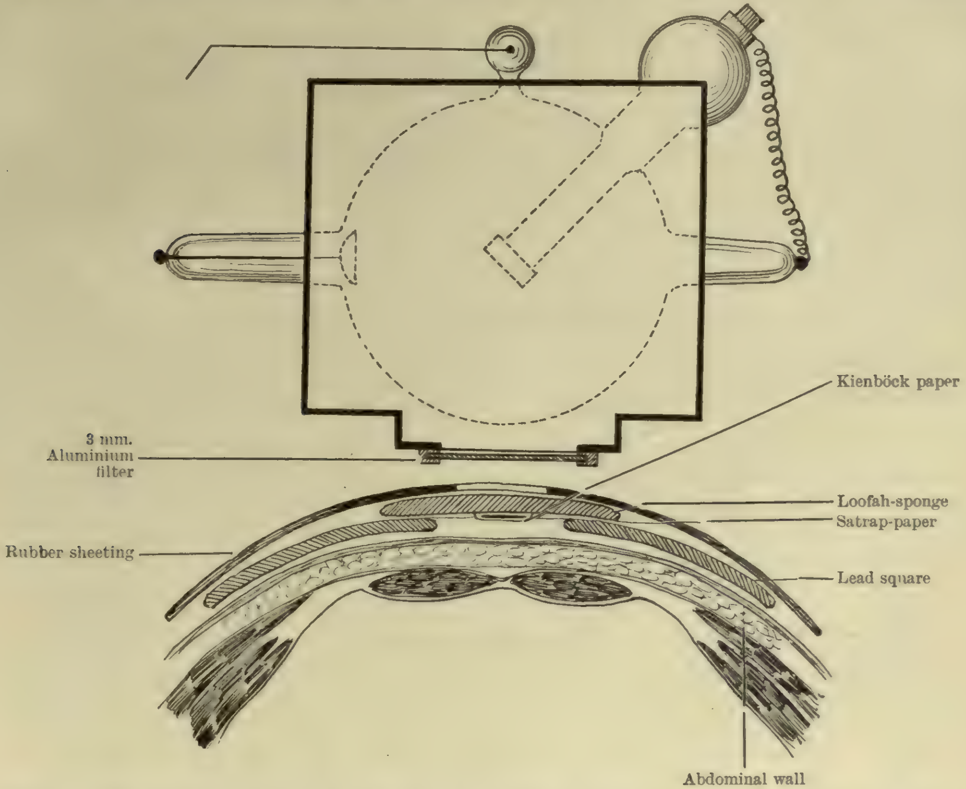


FIG. 326.—Diagram showing tube and various protective appliances to abdominal wall in position.

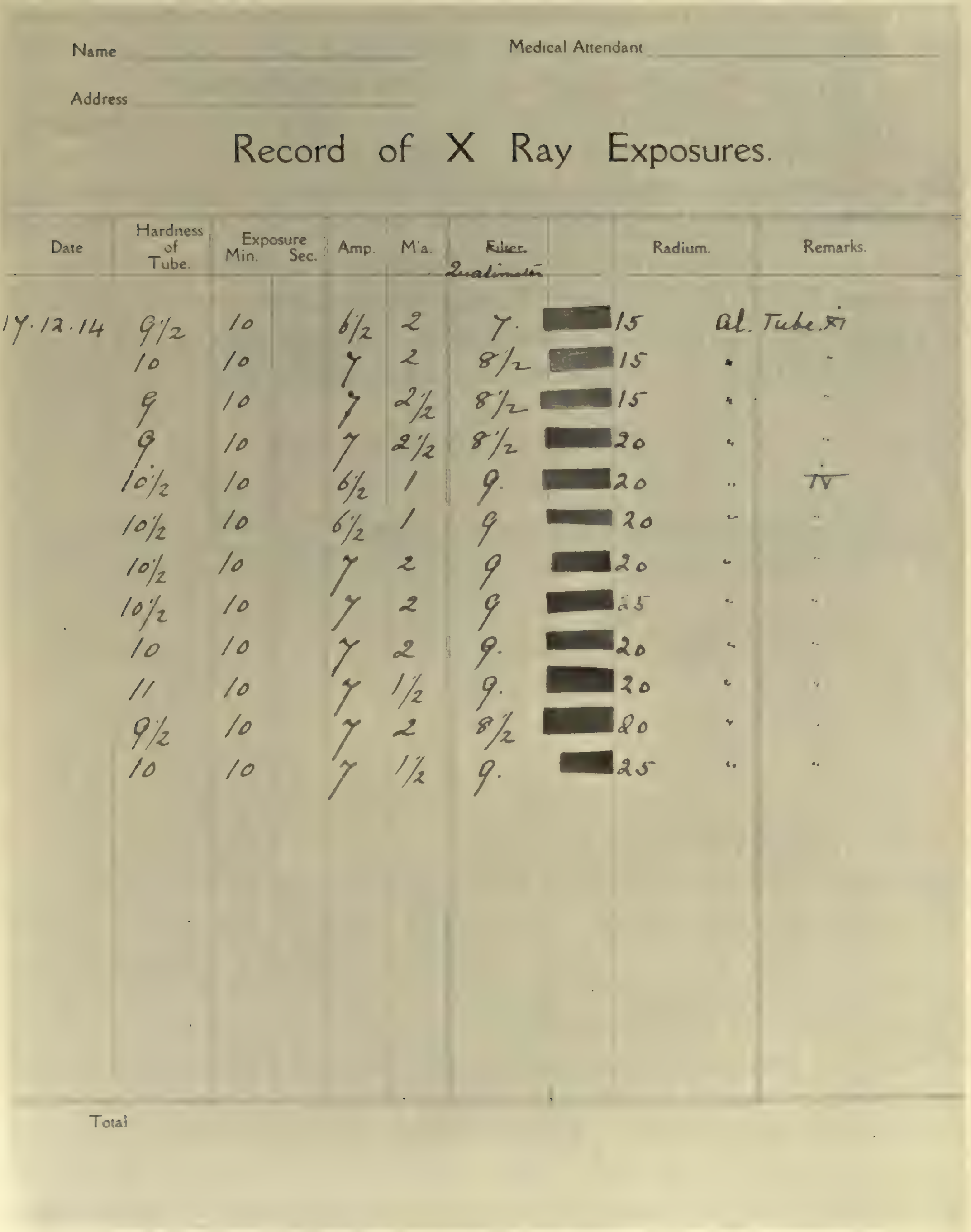
Some operators advise a preliminary course of diathermy, with a view of producing a hyperaemic condition of the tumour. The hyperaemia of the tissues renders them more susceptible to the radiations. The diathermy should be employed for ten minutes and should immediately precede the application of the rays, one electrode being placed on the lower abdomen, the other on the sacral region, and firmly bandaged to the body, so that the plates are as closely and as evenly applied to its surface as possible.

Each area is irradiated for ten minutes and receives a dose of 10 X or more. The rays are projected downwards into the pelvis at various angles, no special attempt being made by cross firing to concentrate the rays upon the ovaries.

Each sitting lasts about 2½ to 3 hours. Three to six sittings are given with an interval of three weeks between each. In cases where the abdominal surface is not of sufficient dimensions to map out twelve areas, eight or nine only are employed and three or four are mapped out over the sacrum and sacro-iliac regions behind and the organs then irradiated from this aspect. In these cases the sitting is frequently divided into two parts, the abdominal areas being irradiated one day and the sacral the following, or even a few days later, as circumstances permit. A chart is kept recording the hardness of the tubes, the length of time of each exposure, number of ampères in the primary circuit, number of milliampères in the secondary circuit, and the doses as estimated from the coloured Kienböck strips (Fig. 327).

Protection of the Operator.—This is a matter of the utmost importance. The ideal plan would be for the patient to be placed in a small wooden apartment, the walls of which should be lined with lead of 3 to 4 mm. in thickness and the door fitted with lead-glass windows, the operator controlling and watching the progress of the treatment from without. Such an ideal arrangement is no doubt difficult to carry out in private practice, but, in its absence, a lead-screen with lead-glass windows acts as a very efficient protection. The operator should also be provided with a pair of leather gloves to protect his hands when regulating the tube in action. The room in which the treatment is carried out should be spacious and well ventilated.

Filtration.—As has already been pointed out, success in the therapeutic use of X-rays depends upon the proper quality of rays being utilized. In the particular branch of X-ray therapeutics under discussion, the administration of rays of a very hard quality is essential, and to obtain such rays we have to make use of tubes of such a hardness that they register 10 to 11 on the Wehnelt scale. Every X-ray bulb, however hard it may be, always emits a certain quantity of soft rays, which, if allowed to act on the skin, would cause serious damage to it. To overcome this difficulty filters are used which, whilst allowing the harder rays to penetrate them, absorb the softer rays, and thus remove the danger that the skin is exposed to if the rays are unfiltered. The filters most commonly used are of aluminium, and vary in thickness from ½ to 3 or 4 mm. or more. Such a filter, though it absorbs the soft rays, has little power to stop the harder rays, but when the latter impinge upon the filter certain secondary rays are emitted by the filter, and are in themselves a source of danger to the skin, and so, with a view of cutting off these secondary radiations, a further protection to the skin is made use of in the form of a loofah-



Name

Medical Attendant

Address

Record of X Ray Exposures.

Date	Hardness of Tube.	Exposure Min.	Exposure Sec.	Amp.	M'a.	~~Filter.~~ Qualimeter		Radium.	Remarks.
17.12.14	9½	10		6½	2	7.	▬	15 al.	Tube XI
	10	10		7	2	8½	▬	15 ..	..
	9	10		7	2½	8½	▬	15 ..	..
	9	10		7	2½	8½	▬	20 ..	..
	10½	10		6½	1	9.	▬	20 ..	IV
	10½	10		6½	1	9	▬	20 ..	..
	10½	10		7	2	9	▬	20 ..	..
	10½	10		7	2	9	▬	25 ..	..
	10	10		7	2	9.	▬	20 ..	..
	11	10		7	1½	9.	▬	20 ..	..
	9½	10		7	2	8½	▬	20 ..	.
	10	10		7	1½	9.	▬	25 ..	..

Total

Fig. 327.—Chart of X-ray exposures recording dosage by Kienböck's method.

sponge, satrap-paper, and chamois leather. With such precautions as much as $1\frac{1}{2}$ to 3 erythema doses may be administered with no fear of producing injury to the skin, an erythema dose being that dose of unscreened X-rays which will produce a slight erythema within fifteen to twenty days of its application.

A great variety of X-ray tubes have been placed upon the market; for the work in hand, the Müller water-cooled tube especially designed to carry heavy currents will be found to be one of the most useful (Fig. 321, p. 823). Of late, however, there has been designed a tube, named after its inventor the Coolidge tube, which promises a great advance upon any X-ray tube yet constructed, and which may be said at the present time to be on its trial. Coolidge, while engaged in experimental work on the substitution of tungsten in place of platinum for the anode of an X-ray tube, was led to construct a tube on entirely new principles (Fig. 328).

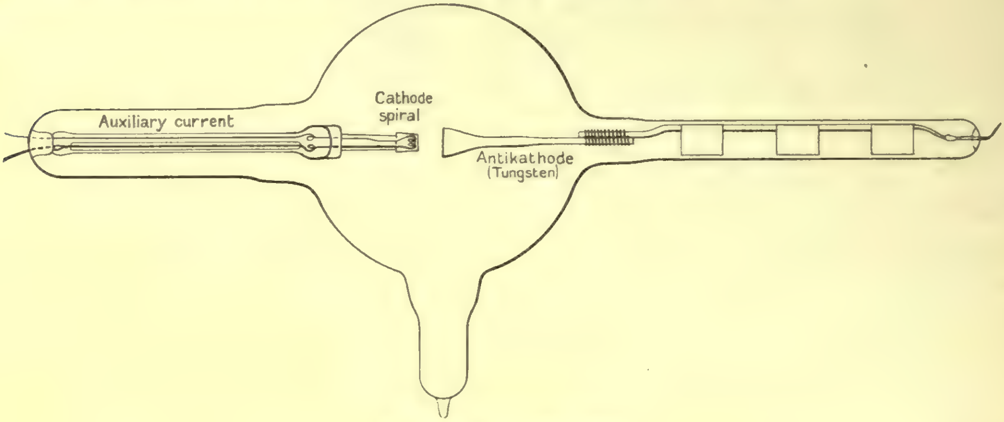


FIG. 328.—Coolidge tube.

This tube has a vacuum many times greater than the ordinary tube; so great is the degree of exhaustion in it, that it is impossible to pass a current through it in the ordinary way even with the most powerful apparatus. The cathode consists of a spiral of tungsten wire, which can be electrically heated, and surrounding which is a cylinder of molybdenum. The heated cathode serves as the source of electrons, while the cylinder so shapes the electrical field as to focus the cathode stream upon the target, or anticathode, which is also made of tungsten. The tungsten spiral is heated to any required degree by the passage of an electric current through it from a small accumulator battery, which has an ammeter and adjustable resistance in circuit. The result of heating the tungsten spiral is to cause a stream of negatively charged electrons to be liberated; these are directed by the high potential electric field on to the anode where they generate X-rays. The number of freed electrons from the cathode is regulated by the degree of heating of the tungsten spiral, and the speed of the cathode stream, upon which depends the penetrating power of the X-rays, is regulated by increasing or diminishing the potential at the terminals of the tube. Figure 329 shows diagrammatically the connection of the Coolidge tube with its storage battery and secondary coil; thus T is the X-ray tube, B a small storage battery, A the ammeter for measuring the current in the filament circuit, R the rheostat for controlling the same, M the milliampèremeter for measuring the current through the tube, and S an adjustable spark-gap with pointed electrodes. As the storage battery is in electrical connection with the cathode of the high potential circuit, it is important that it should be thoroughly insulated from the earth. When working properly the tube should show no fluorescence of the glass at any point; there is also an absence of any heating of the anterior hemisphere of the tube. This absence of fluorescence and of local heating cannot as yet be said to have been satisfactorily explained. Unless the tungsten spiral filament is heated the tube shows no conductivity in either direction even with the highest voltages used. The tube is only capable of producing X-rays when the spiral filament acts as the cathode. The current passing through the bulb is determined by the extent to which the spiral is heated. If the temperature of the filament is low only a small number of electrons escape from it, and consequently only a small discharge current can be sent through the tube. The field of X-rays is conditioned by the degree of heating of the spiral, and the character of the X-rays is determined according to the voltage applied between the terminals. This necessarily follows from the well-known fact that the penetrating power of the Röntgen rays emitted from an X-ray tube increases

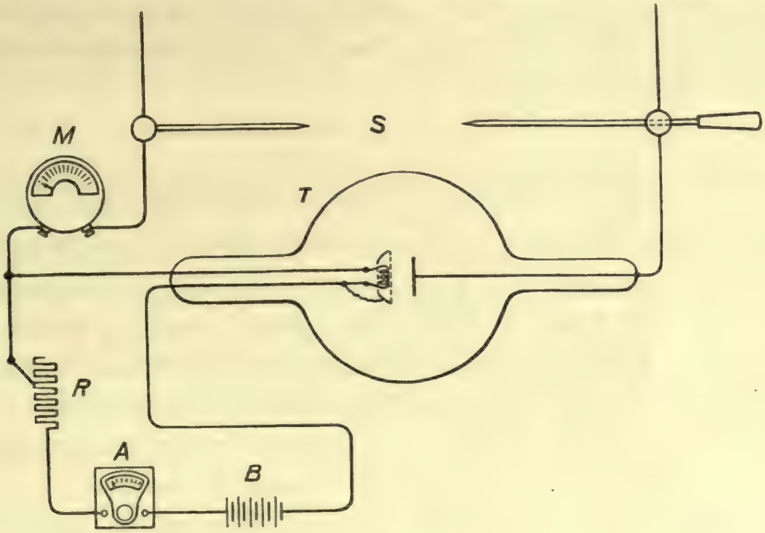


FIG. 329.—Diagrammatic sketch of connection of Coolidge tube.

with the potential difference between the two terminals. The tube may be driven continuously without showing an appreciable change in characteristics. The working life of this tube has been estimated to be at least 1000 hours of constant running, which, if correct, means that it has a life about twice as long as the ordinary tubes. From the therapeutic point of view the great advantage of the tube would appear to be its stability, and its large output of rays of a more or less definite quality at will.

Considerable experience and skill are necessary for the satisfactory manipulating of a Coolidge tube. A thorough schooling in its manipulation under a competent radiologist should be enjoined before adopting its use. Furthermore, when operating with this tube every protective measure possible must be taken to guard both operator and patient against injury. Any neglect on the part of the operator on this point may lead to serious results.

Action of X-Rays in deep-seated Gynaecological Diseases

The introduction of X-rays as a therapeutical agent in gynaecological practice is primarily due to the discovery of the action of the Röntgen rays on the genital organs of animals by Professor Albers-Schönberg. In 1903 Albers-Schönberg[1] published a monograph "About a hitherto unknown Action of Röntgen Rays on the Animal Organism," in which he described certain effects produced by the action of X-rays upon the testicles of rabbits. This paper led to the investigation of the action of X-rays upon the female reproductive organs in animals.

In 1905 Halberstadter and others published the results of their researches on the action of X-rays on the female genital organs of animals, and in the following year Specht, Krause, Fraenkel, and others published the results of their researches upon the same subject. The work of these investigators proved beyond all doubt what a marked effect Röntgen rays have upon the ovaries of animals. The results of their investigations may be summarized as follows: Atrophy of the ovary, disappearance of the Graäfian follicles, degeneration and diminution in number of the primary follicles, together with changes of a fibrotic nature in the interstitial tissue of the gland, and as a consequence of these changes, loss of power of gestation. Their findings were confirmed by several other investigators, and in 1910 and 1911

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[1] Albers-Schonberg, *München. med. Wochnschr.*, 1903, vol. l. p. 1859. Halberstadter, *Berl. klin. Wochnschr.*, 1905, vol. xlii. p. 64. Specht, *Arch. f. Gynäk.*, 1906, vol. lxxviii. p. 458. Krause and Zugler, *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1906, vol. x. p. 126. Fraenkel, *Zentralbl. f. Gynäk.*, 1907, vol. xxxi. p. 953. Faber, *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1910-1911, vol. xvi. pp. 365 and 435. Reifferscheidt, *Zeitschr. f. Röntgenk.*, 1910, vol. xii. p. 233. Simon, *Zeitschr. f. Röntgenk.*, 1911, vol. xiii. p. 371.

Faber, Reifferscheidt, Simon, and others demonstrated an action on the human ovary by X-rays similar to that on the ovary of animals.

The most striking clinical effect of the administration of X-rays in suitable cases is suppression of uterine haemorrhage, menstrual or otherwise, this phenomenon being mainly due to changes brought about in the ovary by the X-rays.

If with the adoption of a suitable technique, the ovary of a rabbit be exposed to the action of X-rays, and afterwards removed and examined, then, according to the time of examination and the quantity of rays administered, the following changes will be observed in the organ. The Graäfian follicles are found to be in various stages of degeneration, the nearer the follicles approach maturation the more marked the degeneration. Fourteen days after the exposure all the developing follicles have disappeared, but a careful microscopical examination of the organ will reveal some primary follicles which have resisted the action of the rays. The interstitial glandular tissue also undergoes degeneration, consisting in an atrophy of the cells, together with a degeneration of their protoplasmic contents (Lacassagne).

Macroscopically the ovary is markedly diminished in size. If an examination of the ovaries of a rabbit is made three to four months after irradiation, one side only having been irradiated, the non-irradiated healthy organ will be found to be ovoid in shape, 20 to 25 mm. in length, and 6 to 7 mm. in breadth, the surface covered with innumerable vesicles, consisting of follicles of various sizes, and weighing from 25 to 30 centigrammes. The irradiated ovary, on the other hand, will be found to be remarkably diminished in size, so much so that it may be necessary to make a careful search to locate it. When found it will be represented by a smooth, flattened, tongue-like process, measuring 10 mm. in length and 2 to 3 mm. in breadth, and weighing not more than ·005 centigramme (Lacassagne).[1]

Histologically the ovary is practically atrophied, it is reduced to a small mass of connective tissue, chiefly fibrous, surrounding a slightly vascular connective-tissue remnant of the organ. A critical examination, however, of this fibrous nodule generally reveals some primary follicles which have resisted the effects of the X-rays. Furthermore, such unaffected primary follicles and remnants of interstitial glandular tissue are capable of recovery, for if the ovaries of a rabbit be examined some six to eight months after irradiation, the technique of administration and the dosage being the same as in the case of the four-months irradiated rabbit, reconstructive changes are observable in the interstitial tissue and primary follicles. The connective-tissue cells of the interstitial portions of the gland become transformed into secretory elements, followed by an evolution of the primary follicles. The latter are sometimes present in such numbers as to re-establish the genital function. No new follicles are formed; the evoluted follicles are those which have escaped the effects of irradiation.

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[1] Lacassagne, *Ann. de Gynécol.*, 1913, 2e Sér. vol. x. pp. 449-457; Albers-Schönberg, *Ann. de Gynécol.*, 1913, 2e Sér. vol. x. pp. 530-540.

Similar changes may be produced in the ovaries of larger animals, though, on account of the difficulty of thoroughly irradiating the ovaries, sterility is more difficult to obtain.

There are changes in organs and tissues other than the ovaries, which are in some respects as important as those observed in the ovaries. Thus Lacassagne found when irradiating large dogs that the animals died after several months. It was found that marked changes had taken place in the alimentary canal, namely atrophy of Lieberkuhn's glands and intestinal ulcerations. No such complications have as yet been reported in human beings, which may possibly be explained by the greater resistance offered by the intestinal canal to the effects of X-rays in the human being than in animals.

The action of X-rays on the human ovary does not differ from that on the rabbit's ovary. Thus in 1910 Reifferscheidt X-rayed six women before operation, their ages being 35, 36, 37, 39, 40, and 52, and each received on an average ½ to 1¼ erythema dose. Examination of the ovaries after removal showed degeneration of the ova in all the follicles, of the follicular epithelium, and the connective-tissue cells of the theca interna, with small capillary haemorrhages in the cortical layer between the cells of the stroma. These results have been confirmed by several other investigators, among whom may be mentioned Faber, Runge, Eyme, and Wolff.

Action on Fibromyomata Uteri.—The reduction in size of fibroids and in some cases their complete disappearance as a result of irradiation is brought about in a twofold manner, namely (*a*) from loss of ovarian stimulation (indirect action), (*b*) from an action of the X-rays on the tumour itself (direct action). The clinical evidence that such a direct action exists is based upon the following observations:

1. Reduction of size of the fibroid occurring in some cases before any amelioration of the haemorrhage.

2. The reduction in size of the tumour in some cases being far in excess of what would have been expected when compared with the diminution in size of such tumours undergone at the menopause or after double ovariotomy.

The diminution in size of fibroid tumours under the influence of X-rays was formerly a debatable subject. At the present time agreement is unanimous, since not only reduction but complete disappearance of tumours has been demonstrated by various investigators. Thus Gauss in 1910 published 10 cases in which tumours had notably diminished after a short interval. Faber, Krausse, Bordier, Foveau de Courmelles, Laquerrier, and many others have published similar communications. Runge reports a reduction in size in his cases in 25 per cent. Albers-Schönberg states he has observed a diminution in size in 45 per cent of his cases, and a complete or nearly complete disappearance in 18 per cent. He remarks: " It is necessary to say that under the heading ' complete disappearance ' it can only be a question of those cases in which a second gynaecological examination has failed to find any sign of myoma which was indisputably there beforehand."

Siegel, in a total number of thirty-six myomata irradiated, noted a complete disappearance in twenty and in the remaining cases a marked diminution in size. Köhler estimates the proportion of diminutions at 30 per cent. Fraenkel records a diminution in size of myomata in three-quarters of his cases.

The changes that have been described as occurring in the tumour-tissues from exposure to X-rays are nuclear necrosis, sclerosis of the uterine mucosa, and an atrophy of the endothelium of the vessels. Fibromyomata, which undergo little or no appreciable diminution in size as a result of irradiation, are probably not very vascular, and histologically poor in cells, containing a large amount of fibrous tissue, and possibly in some cases undergoing calcareous degeneration. Fibromyomata of rapid growth, with a copious blood supply rich in cellular elements, are considered by many authors to be most amenable to treatment from the point of view of diminution in size. Of the two actions by means of which cases of fibromyomata uteri derive benefit from X-rays, the indirect action through the ovarian path is by far the most important.

INDICATIONS

Under certain circumstances the following pathological conditions may be treated with Röntgen therapy: Fibromyomata uteri; chronic metritis and endometritis; menopausal haemorrhage; dysmenorrhoea; leucoplakia vulvae; inoperable carcinoma of the corpus uteri, cervix uteri, and ovaries.

Fibromyomata Uteri.—Of the gynaecological cases that have been submitted to treatment by X-rays, the vast majority has consisted of fibroids. The success which has been achieved in the treatment of these tumours has established Röntgen therapy as a scientific medical procedure, and one which is likely in suitable cases to compete favourably with the recognized surgical methods of dealing with these tumours at the present day, namely abdominal hysterectomy or myomectomy. The success or failure of this method of treatment depends in no small measure upon the selection of suitable cases; it is therefore essential that in the first place a correct diagnosis be arrived at, and that the operator should have a clear picture in his mind of the exact pathological condition of the pelvic organs, which demonstrates the importance of the treatment being always supervised, *and when possible actually carried out, by a gynaecologist.* In certain cases it may be found necessary to examine microscopically tissue removed by the curette, with a view of eliminating malignant disease, or to dilate the cervix and to examine the interior of the uterus with the finger should the presence of a uterine polypus be suspected. In any case of doubtful diagnosis surgical measures should be adopted. As a result of the work of various investigators, chiefly Continental, during the past ten years, there is practically a unanimity of opinion as regards the indications and contra-indications of the X-ray treatment of fibromyomata. These may be conveniently discussed under the following headings :

Age.—No case under thirty-nine years of age should be submitted to Röntgen therapy. The nearer the menopause is approached the more satisfactory and prompt will be the result. The raying of fibromyomata in women who have ceased to menstruate for any length of time is of very doubtful utility. The younger the patient the more prolonged will be the treatment and the greater the liability to recurrence of haemorrhage. This is due to the great resistance offered by young ovarian tissue to the effects of X-rays. The younger the patient the greater will be the quantity of X-rays necessary to produce amenorrhoea.

Nature of the Fibroids.—The interstitial variety is the only one amenable to this form of treatment. The subperitoneal pediculated variety and the submucous polypus contra-indicate Röntgen therapy, and should be dealt with surgically. The age of the fibroid is an important factor. Fibroids of recent date and of moderate size will be found to give the most satisfactory results in every respect. Cessation of haemorrhage rarely fails, whatever the size of the tumour, as a result of treatment, but reduction in size is by no means so constant. Rapidly growing tumours of moderate size and recent date will generally be found to diminish rapidly in size, and even in some cases to disappear entirely. Large fibroids reaching well above the umbilicus, especially if of old standing and unattended with severe haemorrhage, are better dealt with surgically. Even in the case of these large tumours it will generally be found possible to produce amenorrhoea, but the production of any appreciable diminution in the size of these tumours is so very doubtful that if symptoms other than haemorrhage are present, necessitating early relief, operative measures must be resorted to. Cervical myomata, unless of moderate dimensions, causing slight or no pressure symptoms, are likewise better dealt with surgically. Pressure symptoms generally, unless of moderate degree, contra-indicate Röntgen therapy. Calcareous and cystic myomata, as also myomata complicated with softening, suppuration, gangrene, or undergoing any form of malignant change, should be dealt with surgically. Inflammatory diseases of the uterine appendages, unilateral or bilateral, unless chronic and accompanied with slight enlargement only, act as a contra-indication to Röntgen therapy. Cases of myomata complicated with certain general conditions, such as Bright's disease, diabetes, chronic lung affections, arterio-sclerosis, morbus cordis, etc., in which any surgical procedure is attended with grave risk, may be safely dealt with by means of X-rays.

As regards cases complicated with severe anaemia as a result of uterine haemorrhage, there is some divergence of opinion as to the proper course to adopt. An increase or renewal of haemorrhage is very liable to occur after the first application of X-rays ; especially is this the case if mild or moderate doses are employed. On the other hand, to submit such cases to operation is running a grave risk, and though a few fatal cases have been recorded as a result of increased haemorrhage from Röntgen therapy, on the other hand many cases have been recorded in which most excellent results have been obtained. On the whole the consensus of opinion in such cases is in favour of the adoption of X-rays.

The treatment should be carried out *shortly after the termination of the menstrual period.* The first menstruation after treatment may be more excessive than usual ; especially is this likely to be the case if moderate doses are employed. In certain doses X-rays are said to have a stimulating effect upon the ovaries, and when there is an increase in the menorrhagia after treatment, it is attributed to this stimulating action. It is therefore always advisable to warn the patient that her first menstrual period after treatment may be more excessive than usual. The haemorrhage as a rule gradually stops, each successive period becoming scantier until amenorrhoea is established. In some cases the interval between the periods is increased at first, without any alteration in the actual amount of haemorrhage, in others again the interval may be prolonged and the haemorrhage at the same time diminished in quantity. Or, again, if the patient has been in the habit of passing large and copious clots she may tell you that they were fewer and not so large as usual.

In a small proportion of cases a recurrence of haemorrhage after a varying period of amenorrhoea has to be recorded. The younger the patient the greater is the liability to such a recurrence, a fact which is attributable to the great resistance young ovarian tissue offers to the effects of X-rays. In those cases in which the tumour has disappeared or has been greatly reduced in size, and in which the haemorrhage recurs monthly and is normal in quantity, no further treatment is necessary. In most cases, however, it will be found necessary to give one or two further applications of the rays with a view to establishing a condition of permanent amenorrhoea.

Pain when present is generally relieved quite early in the course of the treatment. This is probably due to a modification of the menstrual blood whereby its coagulability is diminished. If the menorrhagia persist after three or four treatments, it is advisable to reconsider the diagnosis and resort to some other form of treatment.

Diminution in the size of the tumour varies considerably in different cases. In some cases it takes place more or less rapidly, in others the diminution is very gradual, in yet others no appreciable change in the size of the tumour can be detected, even after a period of amenorrhoea of six months' duration. In some cases the tumour appears to have disappeared entirely. Soft myomata of moderate size, with a marked tendency to haemorrhage, usually disappear rapidly. Naturally the relief of pressure symptoms, if present, coincides with the period of diminution in the size of the myomata. Occasionally, at first, an increase in size of the tumour, slight in amount, may be noticeable.

Climacteric Phenomena.—In the majority of cases they are few and slight in character, and do not differ in character in any way from those observed at the time of the natural menopause. The younger the subject the more marked are the climacteric manifestations. Bordier suggests that the mildness of the artificial menopausal symptoms may be due to the fact that the rays do not produce ovarian insufficiency, that is to say, that the internal secretion of the glands is little affected by the rays. Many authors claim that the more gradually a condition of amenorrhoea is produced by X-rays, the less manifest will be the reflex disturbances resulting therefrom.

The majority of my own cases have had mild disturbances shortly after the onset of amenorrhoea; in a few, however, they have been moderately severe.

General Phenomena.—The marked tonic effect X-rays have on the general health is well illustrated in the case of patients undergoing local treatment for one cause or another. In nearly every case these patients, before noticing any change in the local condition, observe a great improvement in their general health. This improvement continues throughout the course of the treatment and is to be attributed to the relief of symptoms and also to an improved condition of the blood, many observers having noted a marked increase in the percentage of haemoglobin, together with an increase in the number of the red blood-corpuscles. This improvement of the general health, however, is often observed before any diminution in the haemorrhage has taken place; in such cases the beneficial effects are probably due to some action of the rays upon the blood contents or the blood-forming organs of the body.

After the administration of the long treatment with moderate doses, patients usually complain of feeling tired for the rest of the day; especially is this the case after the first treatment. It is therefore advisable, though not absolutely necessary, to prescribe rest in bed for twenty-four hours after the treatment. This sense of fatigue is sometimes associated with headache, slight nausea, or giddiness, and these symptoms may last twenty-four hours. Such attacks are said only to occur when the milder doses of X-rays have been administered, and never to occur when the massive doses have been employed.

Chronic Metritis.—This condition almost invariably fails to respond to curettage (see Vol. II. p. 117). A very common history in such cases is menorrhagia, for which curetting has been performed with perhaps no effect, or if any, an improvement for three to six months, when the menorrhagia recurs. Curetting is again performed with the same result, and then, as a last resort, the uterus is removed, which of course cures the patient. Such cases, however, when occurring in women over forty, as the majority of such cases do, are admirably adapted to X-ray treatment. Furthermore, a cure can be confidently assured after three or four applications. By limiting the quantity of X-rays administered, moreover, it may be found possible in such cases to reduce the haemorrhage without actually stopping the period, so that menstruation may again occur regularly and normally in such patients.

Menopausal Haemorrhage.—This form of haemorrhage very rapidly responds to X-rays. One application will often be sufficient to cause it completely to stop, never to return. In this variety of uterine haemorrhage, carcinoma of the body of the uterus must be definitely excluded before advising the adoption of X-rays. If there is any doubt as to the diagnosis, curetting should be performed and the scrapings examined microscopically, and the case treated afterwards according to the findings: if malignant, surgical removal, if innocent, X-rays.

Dysmenorrhoea.—Occasionally, but only very occasionally, we meet with cases of painful menstruation which fail utterly to respond to any medical or minor surgical means adopted to relieve the pain. The pain is so severe that the life of the patient is practically rendered intolerable, and as a last resource hysterectomy has to be performed. X-rays might and should be given a trial before resorting to the serious operation of removal of the uterus. Such cases require very large doses, and to effect a cure complete amenorrhoea must be the object in view.

Leucoplakia Vulvae.—In this condition radium will probably be found more effective than X-rays and easier to apply. Nevertheless in some cases a few doses of X-rays combined with the radium will be found to be beneficial, and certainly should be given a trial in this most intractable disease, especially if all other means at our disposal except removing the vulva have failed, as they do only too frequently.

Inoperable Carcinoma of the Uterus and Ovaries.—Inoperable cases only of carcinoma should be treated by X-rays. In operable cases of carcinoma of the generative organs X-rays may be used *after operation* with a view to preventing a recurrence of the disease locally, and it should always be employed in those cases in which, after removal of the diseased organs surgically, there is any doubt as to whether the whole of the disease has been totally eradicated. In all such cases very large doses of rays of the hardest penetration possible should be given, and the treatment should be continued over several months. In the inoperable cases, and in those cases where any growth after operation has been left behind, X-ray treatment may be combined with the judicious use of radium (see p. 851).

The results of treating inoperable cases of carcinoma of the uterus are not encouraging from the point of view of curing the disease. Nevertheless in many cases, if not in all, a temporary arrest of the disease is to be noted, and in all cases a marked alleviation of most of the distressing symptoms associated with malignant diseases of the uterus may be justly anticipated. Thus the pain in the early stages is relieved, the haemorrhage is almost invariably arrested entirely, the offensive vaginal discharge clears up, and with its disappearance the liability to septic poisoning from this source is removed. As a result of the relief of symptoms, together with the tonic effects of the rays, the general health is much improved for the time being, and for some months these patients may live a life of comparative comfort, a condition of things which is in marked contrast with those cases of inoperable carcinoma of the uterus, which are dealt with by the usual palliative measures, namely scraping the growth, applying caustics, and the use of vaginal douches, together with the administration of opiates and tonics.

The growth, when involving the neck of the uterus, becomes converted into a hard dense fibrous mass, and an extension of this fibrous growth may be detected spreading into the connective-tissue planes of the pelvis; the remnants of the cervix may become covered with what feels like healthy mucous membrane to the finger, and an examination of such a case may fail to excite haemorrhage even on scraping the tissue with the finger.

Sooner or later, however, in the vast majority of the cases the growth breaks down again, or secondary deposits occur from the effects of which the patient ultimately succumbs.

A further point of the very greatest importance is the occurrence of vesico-vaginal and recto-vaginal fistulae. Experience in the treatment of these cases tends to show that the liability to such occurrence is markedly reduced. It is not at all common to meet with these fistulae in cases of inoperable carcinoma of the cervix uteri treated solely by X-rays.

The technique is the same in all its details as that described for the treatment of fibromyomata uteri (p. 818).

Conclusions

On the Continent and in America a vast amount of literature has been published on the subject of Röntgen therapy in gynaecology, together with statistical tables of the results of this treatment. In this country, on the other hand, little has been written on the subject, nor can the treatment be said to have received much encouragement from the majority of gynaecologists. The absence of any standardization of the dosage, the injurious effects of X-rays in the early days, and the present doubt as to its remote effects are probably the chief causes of the present attitude of gynaecologists towards Röntgen therapy.

It cannot, however, be denied by any one who has had any experience in the treatment of gynaecological diseases by this agent that Röntgen therapy is destined to hold an important place in gynaecological therapeutics.

We shall therefore pass briefly in review the advantages and disadvantages of the treatment.

The advantages may be enumerated as follows :

(1) It is painless.

(2) It avoids the shock of an operation.

(3) It does not necessitate confinement to bed.

(4) The onset of menopausal symptoms is gradual and in the majority of cases slight in degree.

(5) Its tonic effect.

(6) The treatment in the long run is probably less expensive than that of operation with its attendant prolonged convalescence.

(7) Absence of any mortality to be attached to it.

The disadvantages may be enumerated as follows :

(1) Danger to the skin.

(2) The length of time necessary to effect a cure.

(3) Absence of knowledge of *possible* remote effects.

No comment is necessary on the advantages of this form of treatment ; their existence is indisputable. The disadvantages, when critically investigated, appear to be of very little real importance. Thus, as regards danger to the skin, with the improved methods of filtration and with the treatment carried out by a careful and experienced operator, such a danger can hardly be said to exist.

In the cases treated by the author with the technique already described (p. 818), no ill-effects on the skin have been observed. At most there has been a slight redness of the skin noted in a few cases, and in all a brown pigmentation, which has passed off in the course of a few months, conditions giving rise to no symptoms and calling for no treatment. As to remote effects upon the skin, such as the development of telangiectasis, chronic dermatitis, etc., my own cases are of too recent date to afford any assistance in elucidating this question, but from the published results of Continental operators, it would seem that such remote complications are of rare occurrence. It cannot be denied that such complications have occasionally been observed, but with improved methods of filtration and greater knowledge of the properties of X-rays, it is reasonable to anticipate the elimination of any such disquieting results in the future. From time to time, no doubt, cases will be met with in patients who have ‘ sensitive skins,’ or in whom there is an idiosyncrasy to X-rays. In these cases the treatment should be at once discontinued and other methods adopted. Such cases must be very rare.

The next matter for consideration is the length of time necessary to effect a cure, by which is meant the time necessary to bring about complete amenorrhoea. This will, in the majority of cases, be found to be between three and four months, but improvement may be expected before this, especially as regards general health. The time taken to recover thoroughly from a serious abdominal operation may fairly be said to be from three to four months. So that from the point of view of the time necessary to effect a cure there is little or nothing to choose between Röntgen therapy and surgery. Furthermore, it should be borne in mind that with Röntgen therapy the patient is at no time rendered incapable of carrying out her usual occupation or duties, as she is when surgical means are adopted to effect a cure.

The disadvantage in respect of the length of time necessary to effect a cure can thus hardly be said to exist.

The lack of knowledge of the possible remote effects of X-rays is unquestionably an important disadvantage. It may well be asked what is the effect of massive doses of X-rays upon the intestines and the healthy organs of the body? And if any, are they deleterious? Reference to my own cases is of no value, for they do not carry with them the testimony of time. All that can be said concerning them is that as yet no untoward *immediate* effects upon any of the viscera have been observed. From the reports published by the numerous Continental operators, it would seem that no deleterious effects upon healthy organs need be anticipated, and as has already been mentioned, the danger to the skin by the absorption of the softer rays has been practically eliminated by the improved methods of filtration.

RADIO-THERAPEUTICS

PART II.—RADIUM IN GYNAECOLOGICAL PRACTICE

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The discovery of the X-rays by Röntgen, followed by the discovery of radio-activity by Becquerel in 1896, and the subsequent isolation of radium by the Curies, with the later work of Ramsay, Rutherford, Soddy, and others, has put into the hands of the therapeutist, agents the potentialities of which in the treatment of disease were until then undreamed of. Louis Wickham of Paris was the pioneer on the clinical side, his investigations dealing mainly with the treatment of superficial lesions. He was closely followed by Dominici, who was the first to direct attention to the value of the Gamma ray in the treatment of deep-seated malignant disease.

In this country Mackenzie Davidson and Dawson Turner were among the first workers, and published some interesting results on the treatment of various diseases. Finzi, following on the lines suggested by Dominici, has treated a large number of cases of malignant diseases, and published several interesting papers. Radium-therapy has become established on a fairly large scale, and many hospitals and institutions are now equipped for the investigation of radium and allied bodies on both the physical and therapeutical sides.

The Physics of Radium.—It may be well in the first instance to consider briefly some of the chief physical properties of radium, and to give prominence to those with which we are concerned in the treatment of disease. Radium itself is a white metal with such a strong affinity for oxygen, bromine, chlorine, etc., that it is never met with except in the form of a salt. It may be mentioned, however, in passing that Madame Curie has actually isolated the metal by means of a refined laboratory experiment, but with that we are not here concerned, beyond noticing that the character of the element is now established.

The atomic weight of the metal is 226·4 according to the latest determination. In practice either the bromide or the sulphate is used, depending on whether it is required to dissolve the salt in water or not. The former salt is more favourable for the liberation of emanation, and the latter is preferable where the material is to be used dry, on account of the insoluble and non-hygroscopic nature of the sulphate.

Each milligram of radium bromide contains a definite weight of radium, but here again we must distinguish between the hydrous and the anhydrous salts. It is usual, on account of the difficulty of accurately weighing the bromide dry, to allow it to absorb moisture, and assume its formula to be a $RaBr_2 2HO$. One milligram of this salt contains ·536 milligram of radium-element. It is better, therefore, in describing the dose to speak only of the radium-content of the salt used, for in that way all confusion may be avoided.

The salt when sealed in platinum tubes serves as a source of Beta and Gamma rays. Since the screens generally used in medical work exclude from 70 to 80 per cent of the Beta rays we may confine our attention to the more penetrating type of radiation. And here it must be noticed that we are dealing with a heterogeneous pencil of rays, since both Radium B and Radium C produce the Gamma radiation. It is in fact only after the rays have passed through two centimetres of lead that the softer rays from Radium B are eliminated. The physiological effects must therefore be attributed to the action of a number of rays differing somewhat in wave-length, and not to any special wave-length, although it is probable that there is a special biological action peculiar to each set of ether-pulses sent into the tissue.

It is often convenient to utilize one of the disintegration products in treatment, and for this purpose the radium salt is dissolved in acidulated water and the product pumped off and collected in a suitable applicator. Radium itself only emits Alpha rays during its conversion into the first disintegration product, but this rapidly gives rise to a second substance of decreasing atomic weight which changes to the important product Radium B, and this in turn disintegrates into Radium C. From these two substances come the penetrating rays we require in therapeutic work.

The first product of the radium series is gaseous and is called the ‘ emanation.’ If required, the emanation may be concentrated by condensation through liquid air into glass tubes 1 cm. in length whose internal diameter does not exceed 0·2 mm. The emanation may also be applied therapeutically in the form of water prepared so as to hold the gas in solution.

Blood takes up the same amount of emanation as a saline solution of the same density. Other organic liquids absorb it strongly: at a temperature of 14° C. absolute alcohol dissolves twenty-four times as much as water under the same circumstances. It is in fact sometimes practicable to inject refined petroleum which has been impregnated with radium emanation.

The Action of Radium upon Normal Tissues and upon Tumour Cells.—Radium and X-rays acting upon the tissues produce marked changes in normal and morbid structures according to the quantity of radiations used; the particular type of ray is estimated by its wave-length and its absorption-effect upon the tissues.

The action is not purely a caustic one, though caustic effects can readily be produced if the exposure is too prolonged, or if the filtration is not sufficient. In some growths we deliberately make use of this action to produce necrosis of the mass, in the hope that when the slough separates, the normal tissues will fill in the resulting ulcer. Occasionally it may be observed that enlarged glands are reduced in size with hardly any skin-reaction; even after repeated exposures to the same area of skin nothing more than a slight erythema is produced, yet the enlarged glands situated at a much deeper level slowly diminish in size.

The degree of action induced is dependent upon the duration of the exposure, the filter used, and the quantity of radium employed. Thus, if necrosis of the growth is necessary a thin filter would be used and an adequate exposure given. Here we are making use of the Beta ray almost entirely, as, though Gamma rays are passing through, the percentage of these is so small that in short exposures their effect is negligible. Should it be necessary to act on a deeper structure and at the same time protect the skin from such action, a thick filter of platinum or lead is used. Two millimetres of platinum or four of lead are sufficient to cut off all but the hardest of the Beta rays, while the Gamma ray is practically unaltered.

It is claimed by several authorities that radium possesses a ‘ selective action ’ on cancer-cells. While admitting that it undoubtedly appears to act on such cells, it must be stated that the word ‘ selective ’ is badly used in this sense. Radium possesses an action on all living cells in a varying degree according to the resistance of the particular cell in question. Thus, young actively-growing cells are more readily influenced than matured ones. The cells of a new growth approximate in structure and power of resistance to the actively-growing cells of a tissue. In this way it is conceivable that the cancer-cell is influenced should it at the time of exposure be attacked comparatively early in its life cycle. Should the cancer-cells be of a stronger or more vigorous type, it is possible that the action of the radiation may be a stimulating one and, instead of a decrease in vigour of a particular cell, we may find an increase in activity and a consequent increase in the size of a tumour. It is a fact that some forms of cancer increase in size at a quicker rate after radium has been applied, whilst other types of cancer are more amenable to radium treatment and a diminution in size is obtained.

As stated already, in addition to the action upon the cancer-cell itself radium acts upon all the tissues composing the growth and surrounding tissues unequally. There is a general stimulation of the healthy cells as a result of radium treatment, so long as the exposure is not excessive. If it should be excessive, the action is apt to produce a caustic and ulcerative effect which leads to a local death of the tumour and a portion of the tissues around it. This may sometimes be desirable.

When the effect upon the healthy tissues is confined to a stimulation, we expect to find after an interval of time an increase of fibrous-tissue formation which shuts off the cancer-tissue from its blood-supply, and causes the atrophy of such cells. It is also probable that in addition to the mechanical action upon the blood-vessels a mechanical effect is produced upon the cancer-cells by the connective-tissue proliferation which is a result of the radiations, immature blood-capillaries in the substance of the new growth will also suffer more than those in the connective tissue. The reparative power of the normal tissues is strengthened, enabling them to cope with the invading cells which are destroyed. These changes can be seen in sections removed from cases undergoing treatment.

The changes induced in malignant growths by the action of radium and similar agents, are, so far as we can see, indistinguishable from the degenerative changes seen in cases of growth which have received no treatment, but this important point must be insisted on, that the percentage of cases in which we see these changes is much larger in the group of cases treated by radiations, than in the group which has received no such treatment. It must be admitted that occasionally we see a case of untreated cancer diminish in size, and, in a very small percentage, ultimately disappear. During the treatment of cancer by radiations it is by no means uncommon, in a fairly large percentage of the cases, to see a marked diminution in size produced. In a smaller percentage we actually see the growth disappear, at all events for a time. The local disappearance of a growth is not a cure, for the disease may have, and in the majority of cases undoubtedly has, extended to other parts of the body. Consequently no case can be said to have been cured until we have given the deeper ramifications time in which to develop and manifest their presence. It is therefore important that before we treat the local condition a search be made for secondary deposits. From the point of view of prognosis and treatment this is a most important matter.

The Selection of Cases for Radium Treatment.—It is unfortunate that the class of case which offers the best results in radium treatment should also hold out the best promise of success by operation.

In the present state of our knowledge of radium and its effect upon new growth, we have no hesitation in saying that where a case of malignant disease can be treated early, the choice must be given to operation. The reason for such a statement is that up to the present we cannot tell when a case is going to do well under radium, and valuable time may therefore be lost if we begin with radium treatment and find in the end that an operation is necessary. Admitting, therefore, that in every early case of malignant disease operative measures should come first, there are some conditions where radium should have second choice.

(1) The patient may refuse operation. Radium should then be the remedy of choice, and thorough treatment in early cases may lead to a disappearance of the growth.

(2) The patient may not be in a suitable condition for operation: here also radium may be found useful as a preliminary treatment to operation at a later date.

(3) The operation necessary may be so radical that the risk to life is too great.

(4) Inoperable cases of malignant disease are generally handed over for radium treatment. Many of these cases are hopeless from a curative point of view. Here radium will relieve pain, diminish discharges, check haemorrhages, and frequently heal up ulcerated surfaces of considerable size.

For purposes of comparison of results it is well to subdivide the group of inoperable cases into the following classes:

(*a*) Advanced cases of malignant disease, where it is obviously impossible to hope to do anything beyond the relief of the pain and other distressing symptoms which accompany the condition.

This relief is sometimes a marked feature in radium treatment. Discharges may be lessened, and where haemorrhage is a feature in the case, especially if it be a general oozing from the growth and surrounding tissues, a sufficient exposure to the action of radium will lead to a cessation of the bleeding. Failing the prospect of achieving either of these results, such advanced cases should be left severely alone, as their treatment by radium can only bring discredit upon the remedy used.

(*b*) Less advanced cases, where there may be a prospect of inducing degenerative or inhibitive changes in the tumour-mass which will lead to a diminution in size and possibly bring the case within the range of operative treatment. This may be accomplished in a percentage of the cases we have to treat.

Surgical methods may profitably be combined with the use of radium, and partial operations are a great help to the radium therapist, as it is quite rational to remove as much of the tumour as is possible, in order to facilitate the use of radium. To take an example, a large fungating necrotic tumour of the cervix uteri is not likely to yield to radium treatment alone, while if the surgeon removes as much of the growth as possible, then radium may be employed on the portions of the tumour left behind. Secondary deposits in the glands and areas drained by the lymphatics may be vigorously treated by X-rays and radium combined, and if a diminution in size is brought about, these may be removed at a subsequent operation. Life may be rendered more tolerable and undoubtedly prolonged by such measures.

Several such cases treated by radium and X-rays have shown marked improvement, enlarged malignant glands have been successfully removed, after reduction in size, following upon radiation treatment. Epithelioma of the vulva has in several instances been sufficiently reduced in size by radiation treatment to be subsequently removed, together with enlarged glands in the groins.

In the routine treatment by radium the following factors should always be kept in mind, as a full consideration of them all in each case will help us to foretell the degree of action, and the result likely to follow from treatment.

(1) Type of growth and condition of patient; a microscopical examination should be made if possible.

(2) Size and situation of tumour.

(3) Quantity of radium used.

(4) Filtration employed.

(5) Duration of exposure.

Methods of Application.—There are two methods of application when using radium in gynaecological practice, viz. the employment of: (1) the radium salt in sealed tubes; (2) the emanation in metal or glass tubes.

1. The former method is the one which has been most generally employed, and the quantity of radium in each tube should be 50 to 100 mgr. These tubes are carefully sealed to prevent the escape of the emanation formed inside the tube—the metal employed is platinum which may be of a thickness of ·3 to ·5 mm. Outside this small tube, other platinum or silver tubes may be employed to filter the rays when it is desirable to use only the harder radiations. The radium tube, with its filter, should be sterilized by immersion in pure carbolic, or the outer tube may be sterilized by boiling—when applied externally the tube with its filter should be placed inside a rubber tube of 1 to 2 mm. thickness, this being used to absorb the secondary radiations given off by the filter. Several layers of lint should be placed between the radium tube and the skin-surface. The radium tube may be placed

in the cervical canal or into the uterine cavity, or it may be inserted into the substance of a tumour, or several tubes may be inserted at equal distances to ensure a uniform radiation.

2. The emanation may be pumped into small glass or metal tubes, which are sealed up and the emanation allowed to mature. After a time, it will be found that the emanation tube gives off rays of the same value as those from the parent radium. The equivalent of 100 mgr. of pure radium may be forced into a very narrow metal tube, and this tube can be used in exactly the same manner as the tube containing the radium salt. For this class of work, when a fairly large quantity of radium is available, it is possible to obtain several small tubes for insertion into a growth.

The actual method of applying the radium tubes is of some importance. In the treatment of vaginal and uterine cancer it is necessary that the radium tubes should be placed in close contact with the growth; the tubes should then be packed around with gauze until there is no possibility of any displacement during the exposure. It is advisable in all cases of this kind to give a general anaesthetic, then the growth can be examined and the tubes placed in the correct position. Cases so treated give much better results than those in which the technique is not so thorough.

Joly, and Stevenson of Dublin, have called attention to a method of treatment which ensures a uniform distribution of the radium rays throughout a growth. A number of small fine capillary tubes are charged with emanation; these can be introduced into a hypodermic needle and inserted into a tumour. By using a dozen or more of these an equal distribution of the radiation is obtained throughout the tumour.

The Practical Application of Radium in Gynaecology

Indications.—The diseases in which radium will be found most useful are: (1) chronic endocervicitis, (2) chronic endometritis, (3) pruritus vulvae, (4) epithelioma, (5) cancer of the cervix, (6) cancer of the body of the uterus, (7) sarcoma of the uterus, (8) fibromyomata.

A short description of the technique in each of these diseases is necessary, with an approximate estimation of results and degree of benefit observed in a number of cases treated.

Chronic Inflammatory Conditions of the Cervix may be treated by two methods. (*a*) By the introduction of a metal tube containing radium into the cervical canal, with additional tubes arranged around the lips of the cervix when it is necessary to treat disease situated in the fornices. The metal tube can be firmly fixed to a sound to facilitate the introduction. (*b*) An emanation tube can be made to suit the particular case requiring treatment. It is charged with emanation at a convenient time to allow of a full degree of activity at the time of application. It is possible to have the applicator made to contain the equivalent of 100 mgr. of $RaBr_2$ or more in a very small cubic space, or if it is desired to weaken the action, the applicator may be made larger, and the gas allowed to diffuse itself over the larger space. Having arranged the size and shape of the applicator, and the quantity of radium or of emanation to be used, the next matter is to arrange for the exposure. This will be largely a matter of experience, and each case must be judged on its own merits.

Chronic Endometritis.—When there has been considerable haemorrhage which cannot be controlled by other methods, a radium tube may be introduced into the uterine cavity. It will very often check the haemorrhage and also the semi-purulent discharge which accompanies it. The exposure should be long, and filtration is necessary if it is desired to influence morbid changes in the deeper layers of the endometrium. The treatment should be continued at intervals of three or four weeks until the condition has returned to the normal.

Pruritus Vulvae.—This condition is frequently relieved and occasionally cured by thorough radiation treatment. In some cases X-rays are more useful than radium, while in others radium appears to act like a charm. In other cases it may be well to apply a radium tube to apparently the most actively affected area, while the wider, and possibly less irritated skin-surface may be treated with X-rays. By combining the agents it is often possible to get much better results than when either is used separately.

The exposures to X-rays should be frequent, for several weeks, a dose being given once or twice a week. Filtration is necessary when frequent doses are given, and it should be increased in proportion to the frequency of the dosage.

Radium should be applied in large doses, filters of 2 mm. of platinum enabling exposures of up to twenty-four hours to be given to each area. In the early stages of treatment it is better to give small doses with light filtration, and to wait for a reaction on the skin. Should this relieve the irritation (and it occasionally increases it) it is wise to wait until the reaction begins to subside, and then give another filtered dose, this time increasing the filtration and the duration of the exposure. When all irritation has disappeared, it is advisable to continue treatment for several months in order to maintain the beneficial action of the rays.

Epithelioma of the Cervix.—Operable epithelioma should always be submitted to operation, but instances may occur where it may be desirable to employ radium as the second choice. The results obtained compare favourably with those of operation, that is, there may be an interval of time between the disappearance of the local growth and the almost inevitable recurrence.

In recurrence, and inoperable forms of growth, a preliminary curettage is useful, because it enables as much as possible of the disease to be removed, and it indicates the position of the part it is most desirable to treat. Special applicators can readily be made if emanation is obtainable, and these can be moulded to suit each individual case.

Inoperable Epithelioma.—It is difficult to define the limits of operability, but it is in this group nevertheless that radium finds so large a field of usefulness. All cases should be treated, because it is not possible to foretell what effect radium may have upon the morbid process, and in all cases relief from distressing symptoms may follow an application of radium—pain may be relieved, haemorrhage and discharge diminished, and the condition of the patient greatly improved.

Remarkable results have in some cases followed treatment. The growth has been known to disappear, and a marked general tonic effect has been noticed. Observations on the action of radium in such cases has given rise to a good deal of optimism on the part of several distinguished surgeons and gynaecologists, but the consensus of opinion is in favour of a suspension of judgment until a larger number of cases has been treated, and time allowed to elapse, in order to ascertain the percentage of recurrence.

Duration of the Exposure.—The exposure is always a matter of difficulty, the duration depending upon the object to be attained. In all cases a filter of at least 1 *mm. thickness* of platinum is necessary, save in cases where the tube can be buried in the growth. An exposure of *six hours* will lead to considerable reaction which should slowly subside and cicatricial changes set in. When 2 *mm.* of platinum are employed the exposure will be proportionately longer, *twelve to fifteen hours* being necessary. In advanced cases where there is a considerable amount of ulceration, and the radium tube can be placed in position completely surrounded by growth, much longer exposures may be made, an exposure of *twenty-four hours* or more resulting in a breaking down of the ulcerated surfaces, and the replacement of the tumour elements by fibrous tissue. In early cases it is well to proceed cautiously, giving small doses at frequent intervals, and carefully watching for reaction and improvement.

When the latter sets in, it should be carried on by judiciously administered doses until the whole of the growth has disappeared. When such a fortunate result is obtained, it is still necessary to continue treatment with thicker filters in order to reach the outlying portions of the growth. In the experience of several workers an apparent cure of the local condition has been followed, in a short period of time, by involvement of the deep pelvic glands, leading to the death of the patient. While radium does not appear to exercise any influence over these growths, it is probable that if the radiations could be applied in sufficient intensity the growth might be checked. It is possible that the doses given for the local condition may have exercised a stimulating influence upon the more distant portions of the growth. In all exposures the ruling factor is the quantity of radium used. The doses suggested above are taken as for 100 *mgr. in ½ mm. platinum tube*, and at least 1 mm. of silver. When the ½ mm. tube alone is used the exposures are proportionately less.

Carcinoma of the Body of the Uterus. Sarcoma of the Uterus.—*Sarcoma is more responsive to radium than carcinoma*, and a number of cases have been treated. Dégrais and Bellot quote a number of cases in which treatment was followed by a disappearance of the growth. Radium tubes should be introduced into the cavity of the uterus in close proximity to the growth and packed into position with gauze; the exposure will vary with the quantity of radium and the size of the tumour. This condition should in all cases be treated surgically when possible; failing complete removal, treatment by radium should be employed. The cervical canal should be deleted to allow of the insertion of the radium tubes; the methods described for epithelioma are equally applicable in this condition.

Fibromyomata.—The technique of X-ray treatment was fully described on p. 816, as also were the class of cases likely to be benefited therefrom. The same types can be successfully treated with radium, or with X-rays and radium. The exposures may be made in four directions: (1) through the anterior abdominal wall; (2) from the perineal aspect; (3) tubes can be introduced into the interior of the uterus or the vagina; (4) from the back.

The two agents may be combined. The X-ray exposures should be made in accordance with the special technique, and a radium tube or tubes can be introduced into the vagina and left there for the necessary time. Mesothorium can be used instead of radium or to supplement its action, when the available quantity of the latter is not sufficient.

Results obtained by the use of Radium and Mesothorium in the Treatment of Malignant Disease.—It is too early as yet to summarize results and make positive statements on the value of radium and mesothorium in the treatment of malignant disease. While undoubted and even marked improvement may be induced in the condition of a malignant growth, the claims of many writers that radium is a specific cure are not yet proved. The local disappearance of a growth is unfortunately not a cure, as it has frequently been observed that if patients who are apparently cured are kept under observation long enough, recurrence will, sooner or later, be found in a large percentage if not in all of the cases. When the disease is distinctly local the prospect of improvement from radium treatment is great, but the prospect of immediate and permanent improvement from early operation is greater, and this point should not be lost sight of. Therefore, in the present state of our knowledge, it is not wise to use radium when a radical operation holds out a better prospect of cure; further, the use of radium and mesothorium in these early cases is open to the objection, that if a marked effect is not speedily produced, there is danger not only of the loss of valuable time, but also of a rapid dissemination of the disease to other parts.

Again, the majority of writers are agreed that these agents do not appear to exercise any influence upon metastatic growths, nor, in cases where the local lesion has been cured but the neighbouring tissues have been invaded, does radium seem to check the further extension. This may be, to some extent, the result of faulty technique, insufficient dosage, and inadequate filtration.

The writer is distinctly of opinion, from personal observation of several cases treated, where the local condition had practically disappeared and was to all appearances cured, that large secondary growths quickly made their appearance in tissues remote from the area irradiated, and developed so rapidly, that the treatment by radium had increased the vigour of these secondary growths. Vigorous treatment of these with large quantities of radium failed to check their progress.

The inference is, that radium possesses a purely local action, whose point of intensity is on the tissues with which it is immediately in contact. The tissues nearest to the radium receive a lethal dose so far as the cancer-cells are concerned, while the normal tissues are possibly stimulated, and the resulting hypertrophy leads to an excess of fibrous-tissue formation and later to cicatricial tissue.

The activity of the radiations diminishes inversely as the square of the distance, consequently tissues at a greater distance from the radio-active agent receive a proportionately diminished dose. It is therefore possible, indeed highly probable, that cancer-cells at a particular distance receive a stimulating instead of a depressing dose, and so rapidly increase in size. In order to give such distant cells a lethal dose, the radium tube must either be introduced into close proximity with the cells, or the radiation from a distance must be prolonged until these distant cells have received the same dose as those near the source of radiations. In the latter case it is probable that the tissues near to the radium will receive an enormous overdose resulting in a severe burn which may lead to necrosis and sloughing. It is possible to overcome this danger to some extent by increasing the filtration of the radium rays. In dealing with cases of this kind, it is sound policy to combine X-rays with radium, using the former in areas away from the local growth, and following up the line of lymphatic distribution; thorough irradiation with filtered rays over these parts should be employed simultaneously with the local treatment of the growth by radium or mesothorium. This combined method of treatment had been extensively employed by the writer for several years, with results showing improvement on cases where either agent alone has been employed.

Krönig, in summarizing the results obtained at the Freiburg Clinique, refers to 254 cases of cancer treated with Röntgen rays and radium. This number includes all cases treated after operation for the prevention of secondary growths as well as those cases treated where an operation had not been performed. Of 150 cases treated where no operation had been performed, 140 were treated by the combined use of X-rays and mesothorium, while 10 cases were treated with Röntgen rays alone. Sixty-four cases were treated for the prevention of secondary growth after operation for cancer; of these 43 were treated almost exclusively with unfiltered rays. While 23 of the 43 cases undoubtedly died from carcinoma, it was found, from following up the subsequent history of the 20 remaining cases, that 19 were free from carcinoma. In dealing with these results it is necessary to know details of the primary growth operated on—its size, the nature of the secondary invasion, if any, the nature of the operation, and the time that has elapsed since the operation.

Krönig states: "While sufficient time has not elapsed to speak of them as definitely cured cases, yet the result is so unusual that to treatment by radium must be attributed the fact that recurrences are not as frequent when filtered rays are used after operation." The writer emphatically endorses this statement. In arriving at opinions as to the result of their therapeutic use of radio-active substances the 140 cases were divided into—

(1) Those in which the cancer is limited to the primary focus.

(2) Those in which the surrounding tissues have been invaded.

(3) Those cases in which not only the neighbouring tissues have been invaded, but in which there have also been metastases in distant organs.

No cases of metastatic cancer have been cured in the Freiburg Clinique. In those cases where the disease has invaded neighbouring tissue Krönig and Gauss have also been unable to produce a cure, though they have seen some remarkable retrogressions and transitory cessations of growth; but so far as these observers have been able to judge renewed activity of the growth occurs later.

The above authorities have had cases in which not only retrogression of the growth in the primary focus has occurred, but also in the parametrium and in the neighbouring glands, so that carcinoma could no longer be found during an observation-period of more than a year.

In cases of the first group where the cancer is still a local disease and has not advanced beyond the primary focus—in other words, the cases ordinarily termed operative, they have observed a complete disappearance of the growth, as far as can be recognized histologically even after deep incision into the tissues.

The case of cure, longest observed in the series, is one of a large carcinoma in the abdominal wall which has been under observation for only two years.

These results are in marked accordance with those observed by the writer during several years' work at the Cancer Hospital, London, where several hundreds of cases of all forms of cancer have been treated.

The prophylactic treatment by X-rays and radium, separately or combined, is carried out in nearly every case after operation, and the writer is of opinion that this prophylactic treatment is undoubtedly beneficial when conducted in a systematic manner. The patients are treated at regular intervals for at least two years, and then kept under observation when possible for a further two or three years. In following out a routine of this kind, it is possible to detect a recurrence at the earliest possible date and to deal with it promptly.

In this connection it may be stated that while carrying out this routine observation on patients apparently cured, recurrences have been observed at later dates than one or two years, and occasionally more than one recurrence in the same patient has been successfully dealt with.

In conclusion the writer feels that radiation-treatment has a useful place in therapeutics :

(1) As an adjunct to surgical treatment, as a prophylactic measure after operation, or as a means of reducing an inoperable case to an operable condition.

(2) As a palliative in the treatment of inoperable cases.

(3) For the tonic effect which it induces.

The Combined Use of X-Rays and Radium-Rays in Gynaecology, particularly with reference to Malignant Disease.—From a consideration of the foregoing observations on the therapeutic use of X-rays, radium, and allied bodies it will be seen that the action is somewhat similar in each agent, and that if the two are employed together the range of usefulness is considerably extended. In one case, the softer X-rays may be the most useful, while in another, the hardest Gamma rays may be necessary to exert an influence on the cell-growth of an invading tumour. Moreover, as the resistance of the cancer-cell varies in parts of the same growth, it is reasonable to assume that if the whole range of available radiations be employed on a particular case, the greater is the chance of inhibiting its activity. It is probable that with increasing knowledge of the reaction-value of particular types of tumour, it will be possible to select a particular ray to act on each, but until this can be done it is better to use all the available resources, in the hope that some good may follow.

The most useful method of attack is the combined one: radium internally and X-rays from all possible ports of entry. The technique is fully described in the foregoing pages and need not be repeated here.

Post-Operative Prophylactic Treatment.—The most useful field for radiation therapeutics is that of prophylaxis. All cases of malignant disease after operation should be submitted to a thorough and systematic course of X-ray treatment, supplemented when necessary by the use of radium. There is reason to believe that cases so treated run less risk of early recurrence, and when recurrence does take place, it is still possible to reduce it or even to cause it to disappear, if further careful treatment is carried out.

The technique should be similar to that used for fibromyomata, and it should be employed as soon after operation as possible; the patient should receive a complete séance of treatment at least *once a month for six or more months*, and should be kept under observation for another year in order that a recurrence may be treated without loss of time.

In this way, the surgeon may find in X-rays and radium a most useful adjunct to his other treatment; apart from the curative action previously described X-rays have an undoubted tonic effect upon the patient generally, convalescence after operation is hastened, and the general tone is improved.

In recurrent growths which are apparently inoperable, the effect of thorough radiation-treatment should always be tried, as it is sometimes possible so to reduce the condition as to raise again the possibility of operation.

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